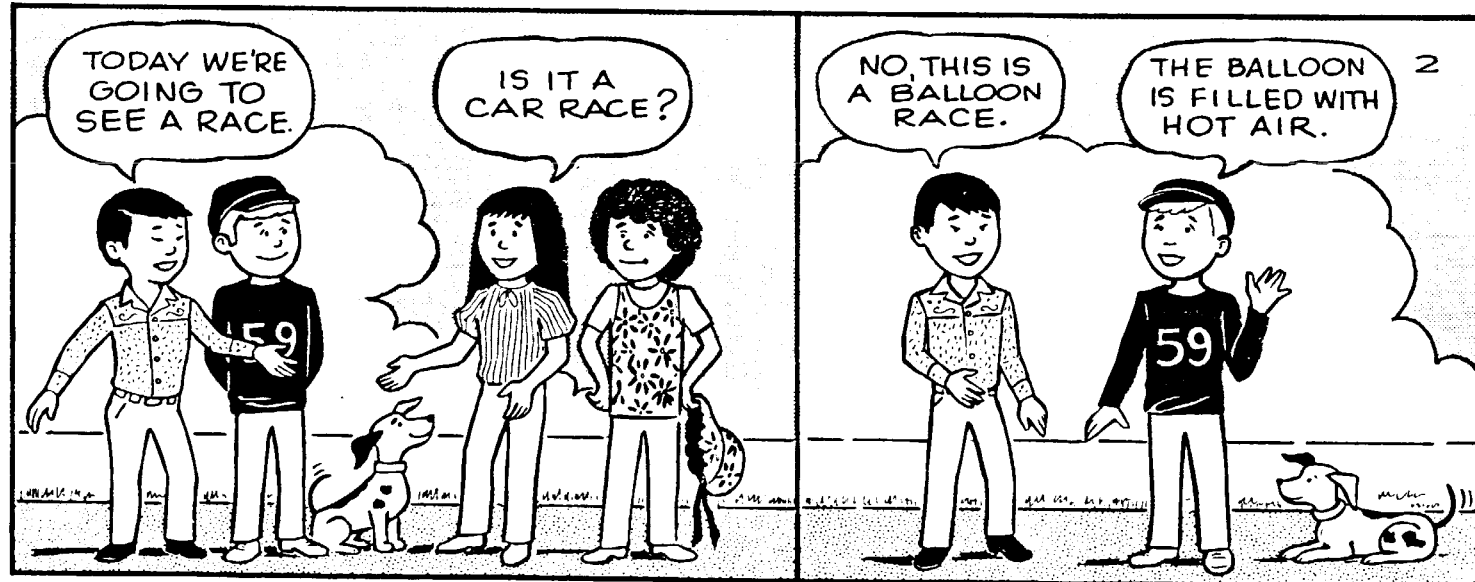
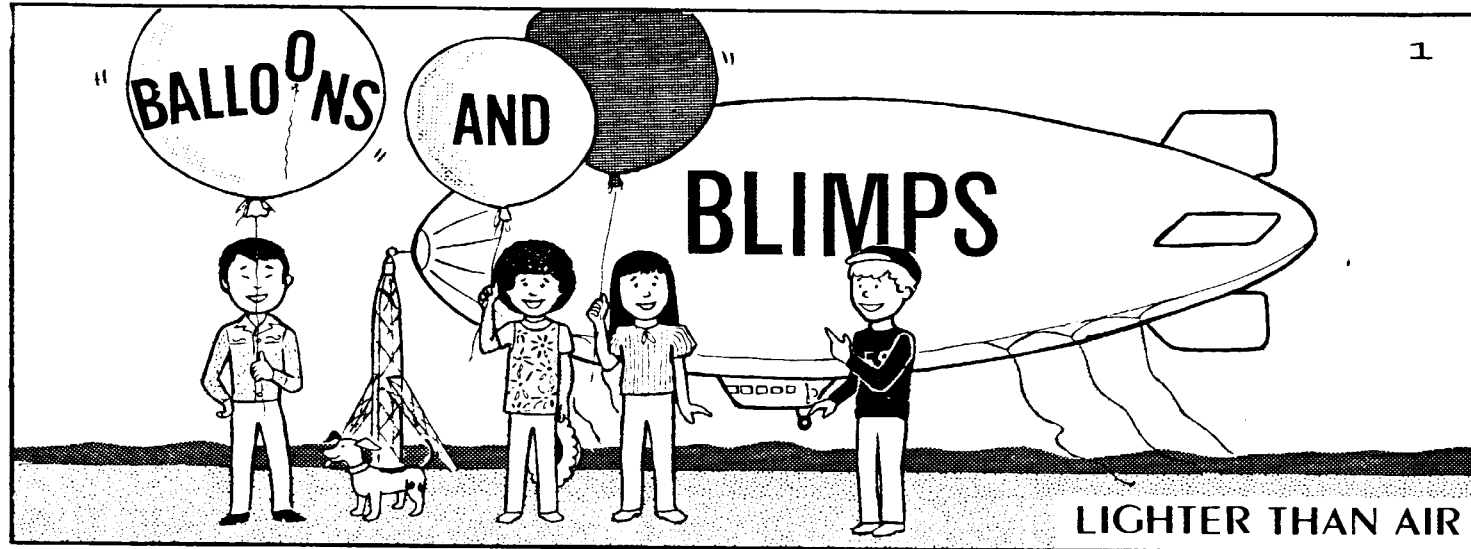


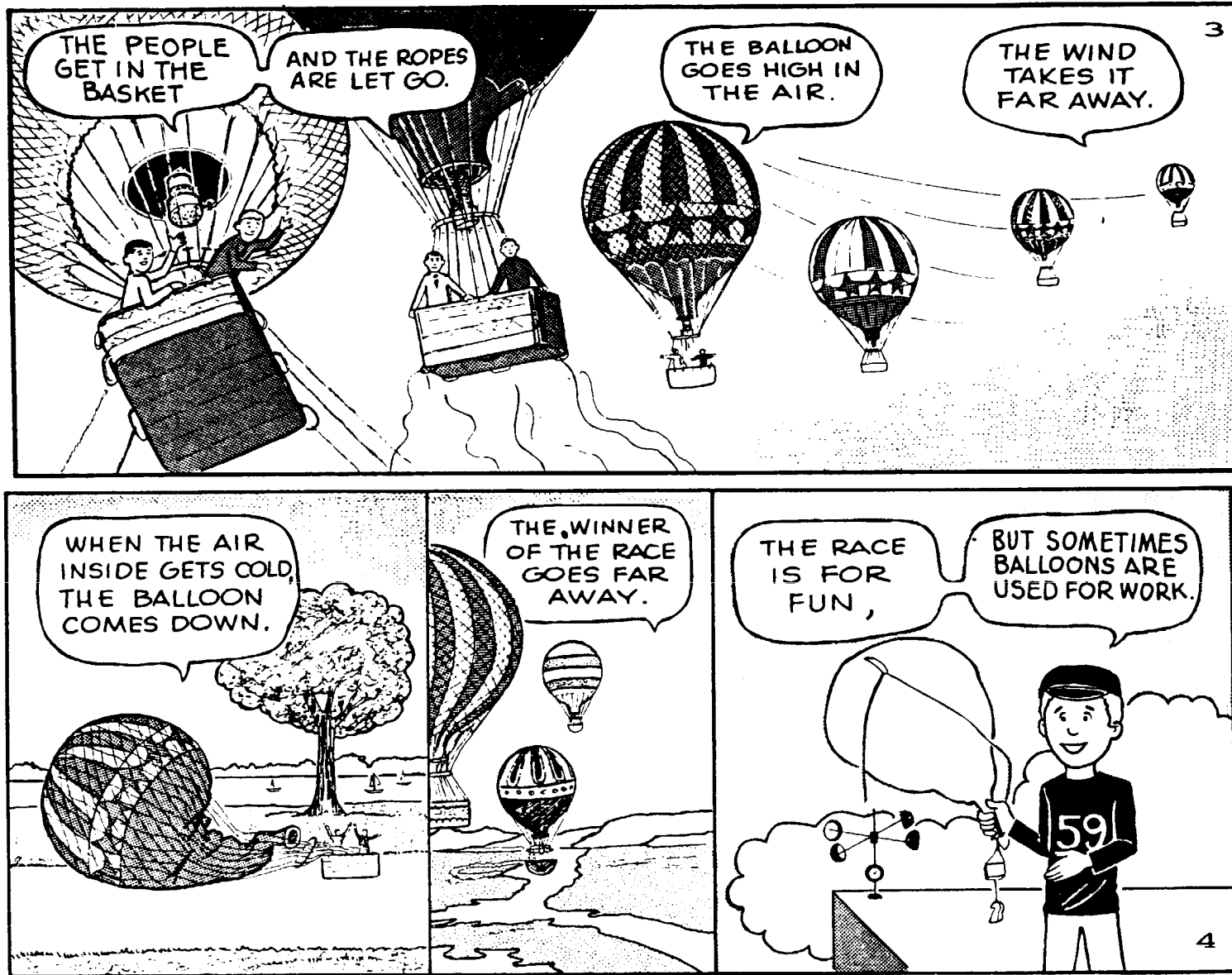
## UNIT 2 ACTIVITY 3

### STUDENT HANDOUT 3



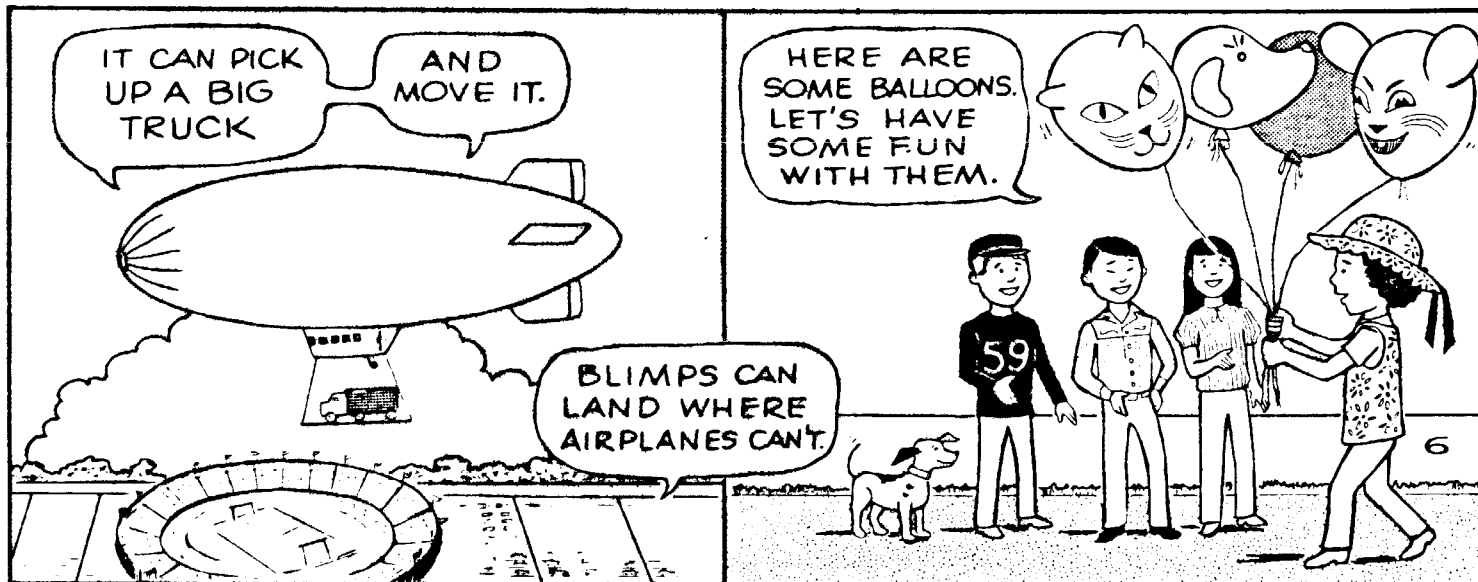
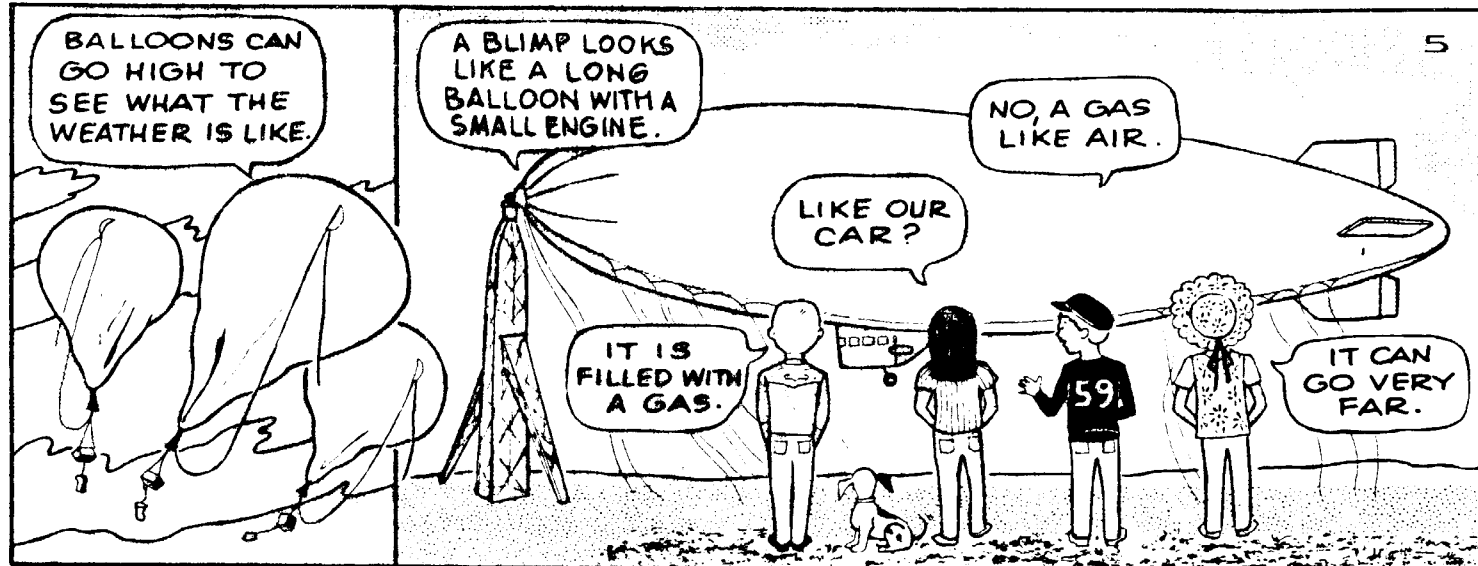
## UNIT 2 ACTIVITY 3

### STUDENT HANDOUT 4



## UNIT 2 ACTIVITY 3

### STUDENT HANDOUT 5



## UNIT 2 ACTIVITY 4

### STUDENT HANDOUT 6

#### HELICOPTERS

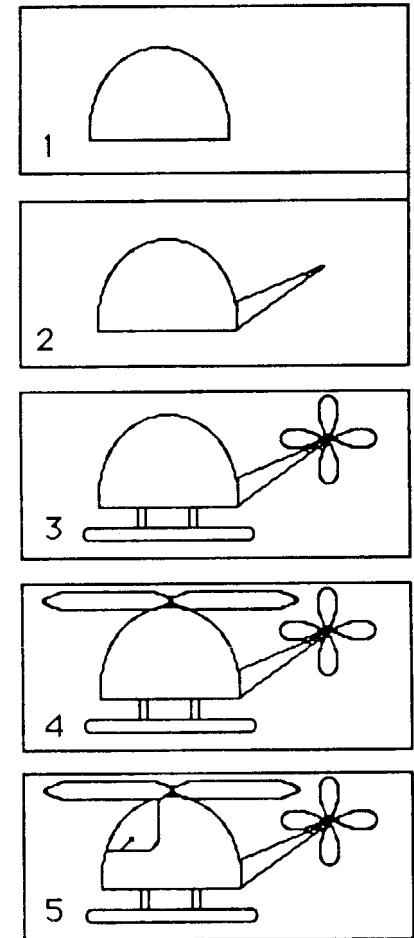
Helicopters are different from airplanes.

Helicopters do not have wings. They have blades called rotor blades. These blades are on top of the helicopter. The helicopter's engine turns the blades round and round in a circle. The turning blades lift the helicopter into the air. When taking off or landing, helicopters can fly straight up and straight down. While in the air, they can hover, or stay in one place. Helicopters can fly much closer to the ground than airplanes.

People use helicopters to do many jobs. News reporters in helicopters check traffic on busy highways. Paramedics rescue accident victims in helicopters and fly sick and hurt people to hospitals. The coast guard looks for boats lost at sea. Busy women and men travel by helicopters across big cities to avoid traffic tie-ups.

#### HELICOPTER ART

Use the five easy steps to draw a helicopter. Complete the picture by showing the helicopter doing one of the jobs in the story.

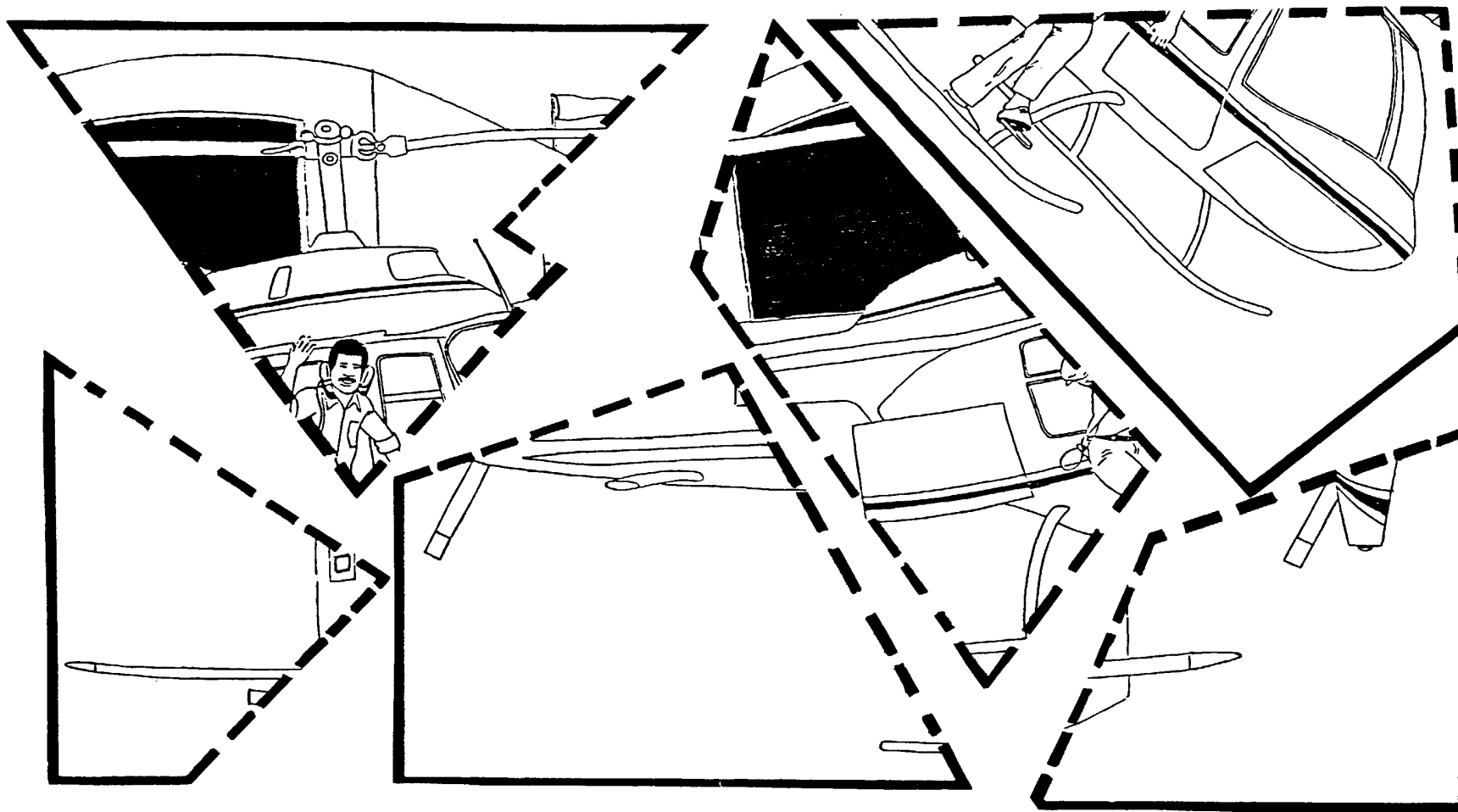


## UNIT 2 ACTIVITY 4

## PICTURE PUZZLE

### STUDENT HANDOUT 7

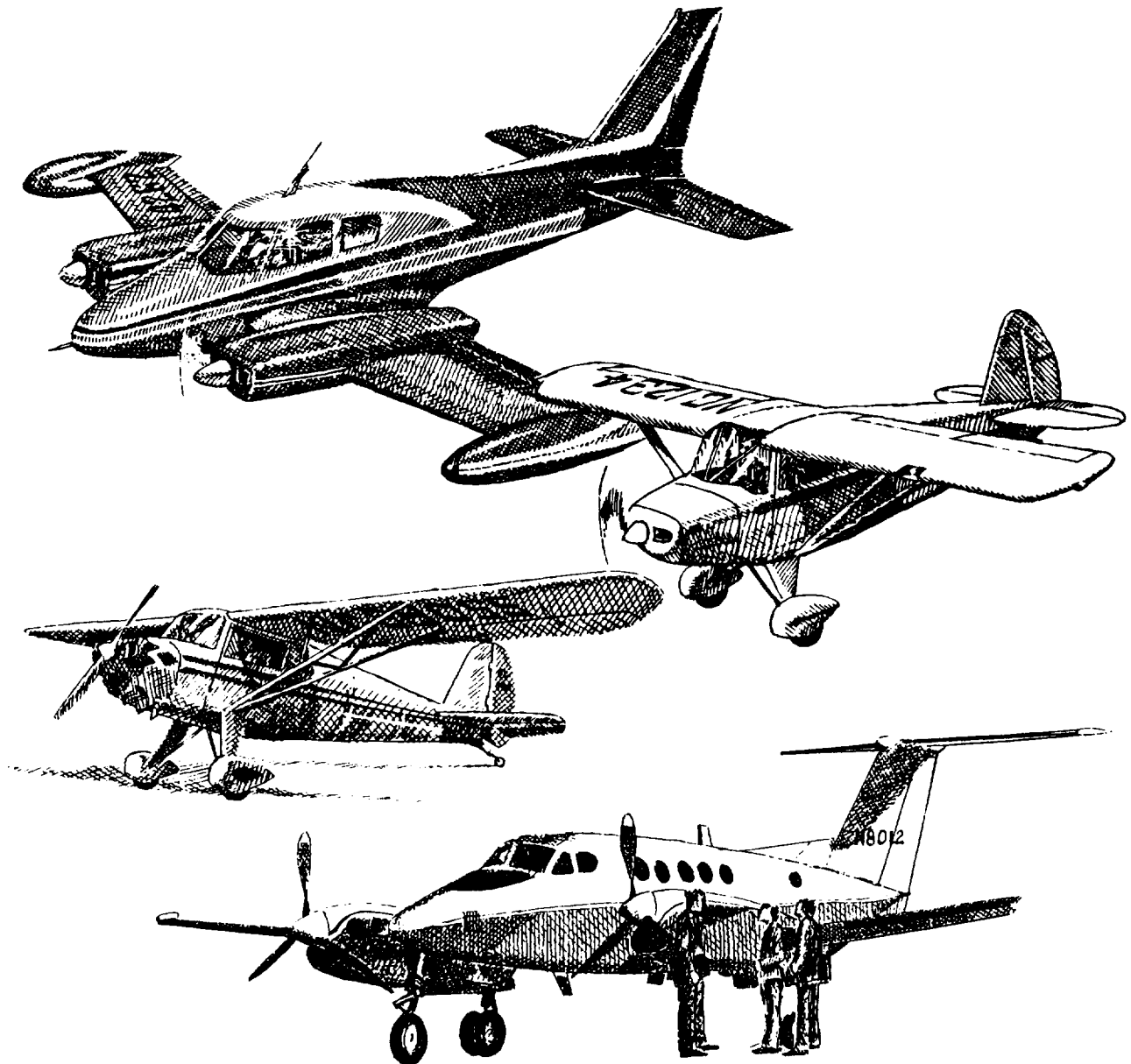
This picture puzzles Art! Help him by cutting out the pieces and putting them back together. Glue the completed puzzle on a piece of cardboard. Color the picture.



## UNIT 2 ACTIVITY 6

### STUDENT HANDOUT 8

Directions: Color the airplanes with one engine red. Color the airplanes with two engines blue



\_\_\_\_\_ airplanes have one engine.

\_\_\_\_\_ airplanes have two engines.

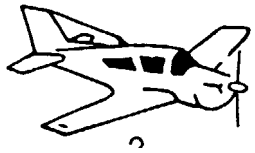
## UNIT 2 ACTIVITY 6

### STUDENT HANDOUT 9

Directions: Read each airplane description.  
Cut and paste next to the correct  
airplane.



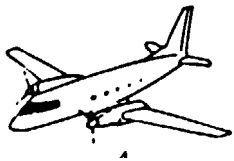
1. \_\_\_\_\_



2. \_\_\_\_\_



3. \_\_\_\_\_



4. \_\_\_\_\_

I have one engine. I can  
land on a grass strip.

a

I like big airports. I carry many  
passengers. I have two strong engines.

b

I have one engine. I can take my owner to  
his home on the lake.

c

My passengers like to fish. My big  
engines help me move many passengers  
and heavy cargo. I will land near the fish.

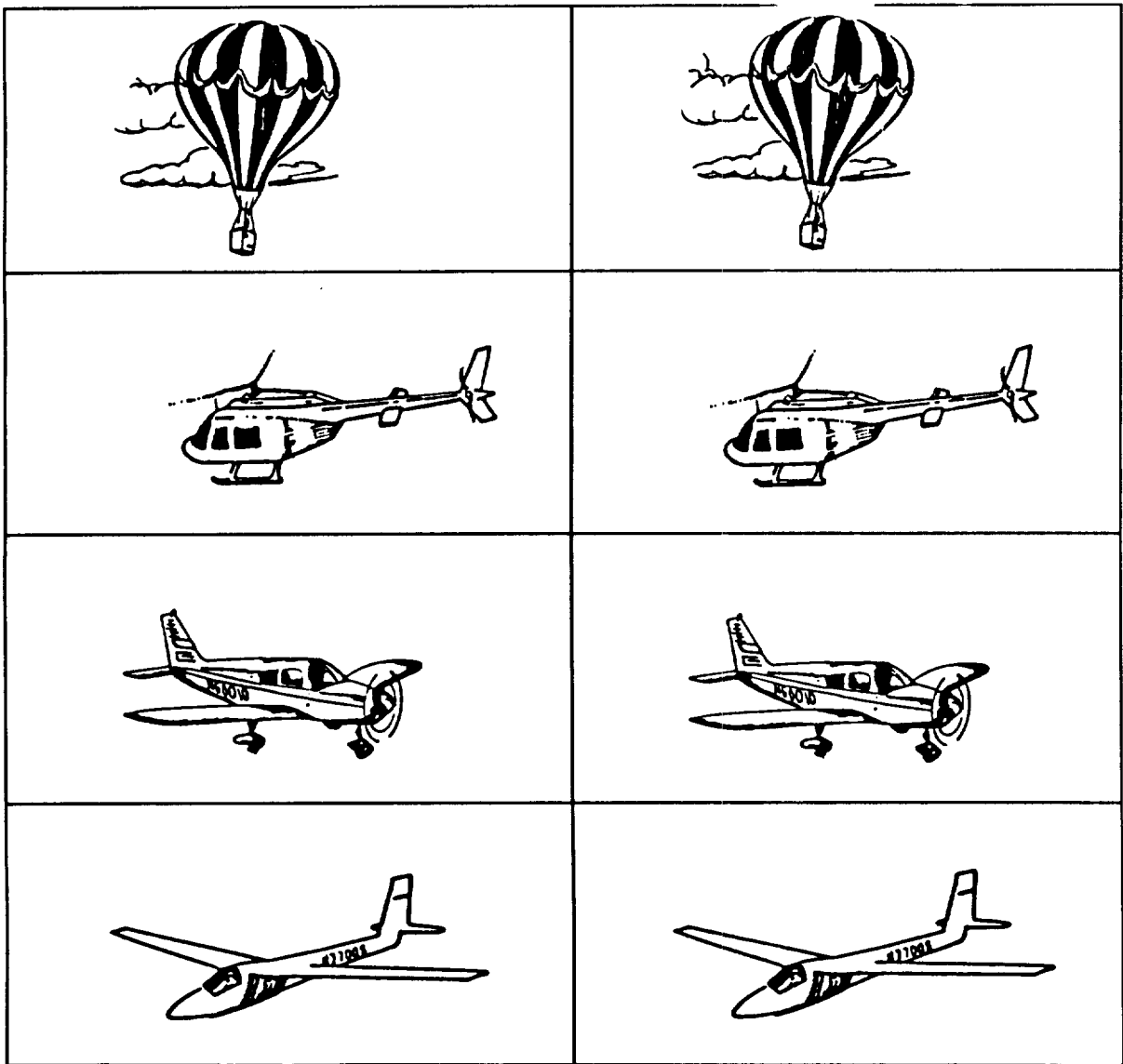
d

## UNIT 2 ACTIVITY 2

### STUDENT HANDOUT 10

#### AIRCRAFT MATCH GAME

Directions: Color aircraft. Cut apart and glue to cards. Place cards face down on table. Draw two cards. If they match, keep them and take another turn. If they do not match, return face down to the table. Move to next player. Play in groups of three.





## UNIT 2 ACTIVITY 6

### STUDENT HANDOUT 1 1

Directions: Color a box for each aircraft characteristic.

#### AIRCRAFT CHARACTERISTICS

	Balloon	Blimp	Glider	Helicopter	Airplane
Wings					
Engines					
Rotor Blades					
Wheels					
Needs a runway for landing					
Can move many passengers plus cargo					
Used mostly for fun					

## UNIT 2 ACTIVITY 6

### STUDENT HANDOUT 12

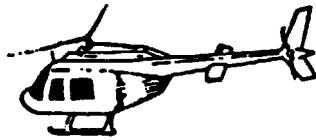
### KINDS OF AIRCRAFT

---

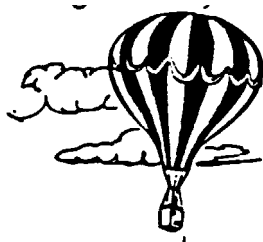
helicopter, rocket, balloon, glider blimp, airplane

---

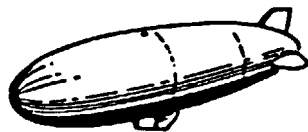
Directions: Use the words above to complete the sentences below.



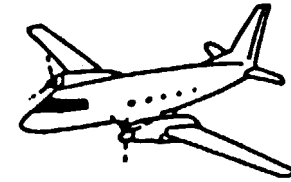
1. The \_\_\_\_\_ has no wings. It does not need a long runway for take-off or landing.



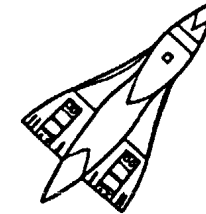
3. The \_\_\_\_\_ has no wings or motor. It is a fun aircraft.



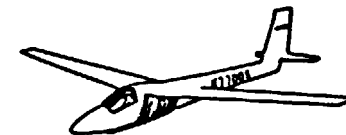
5. The \_\_\_\_\_ has a motor and no wings. Only a few of these aircraft exist.



2. The \_\_\_\_\_ has a motor and wings. It can move people and cargo quickly over great distances.



4. The \_\_\_\_\_ takes off from a launch pad. It has taken man into space.



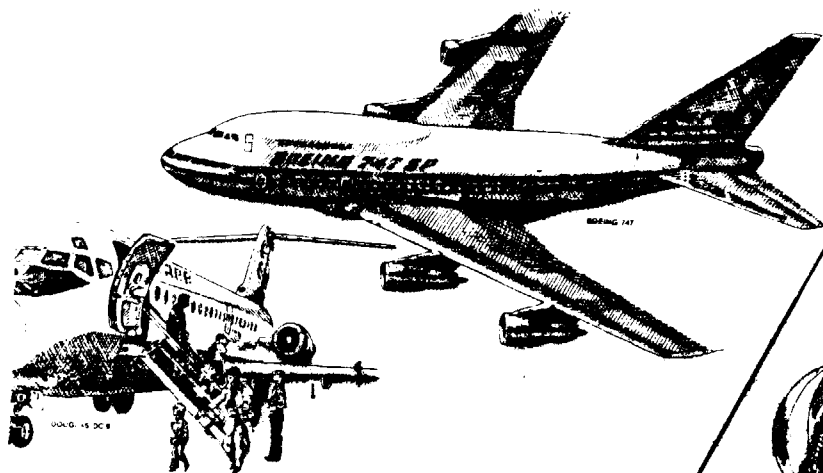
6. The \_\_\_\_\_ has wings and no motor. A towplane helps it become airborne.

## UNIT 2 ACTIVITY 7

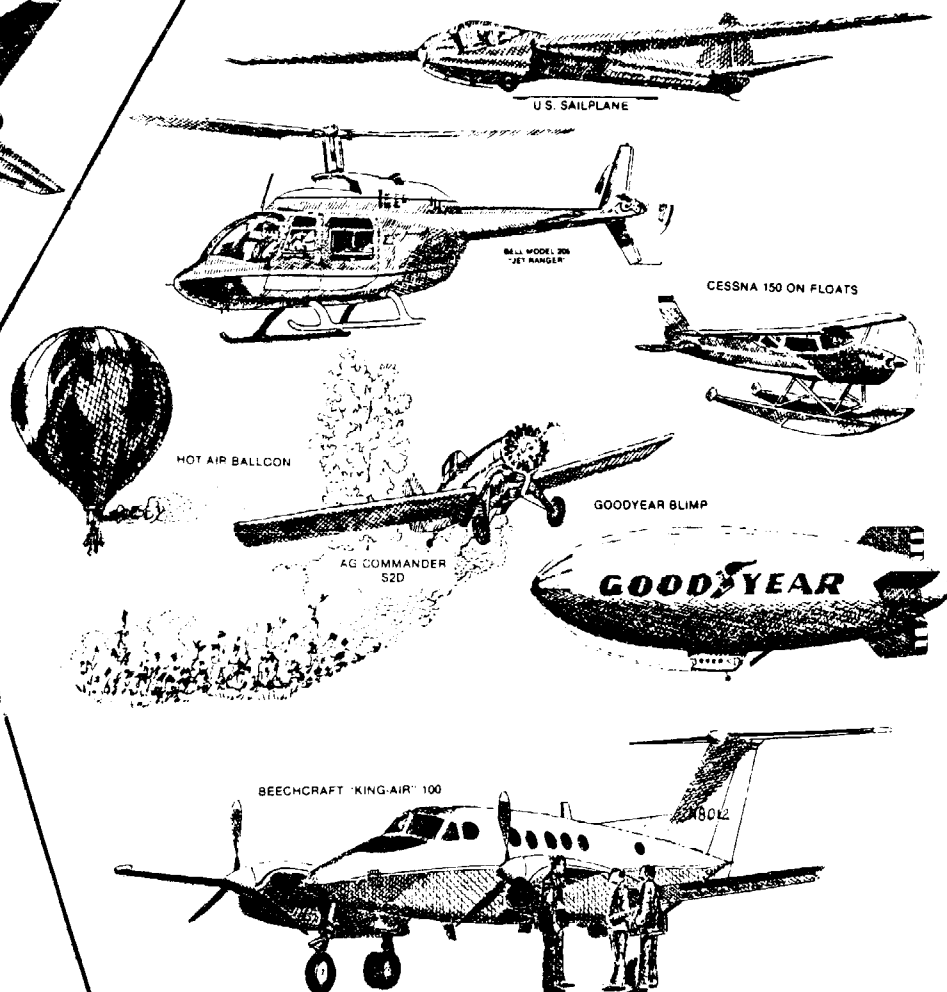
### STUDENT HANDOUT 13

#### AIRCRAFT USERS

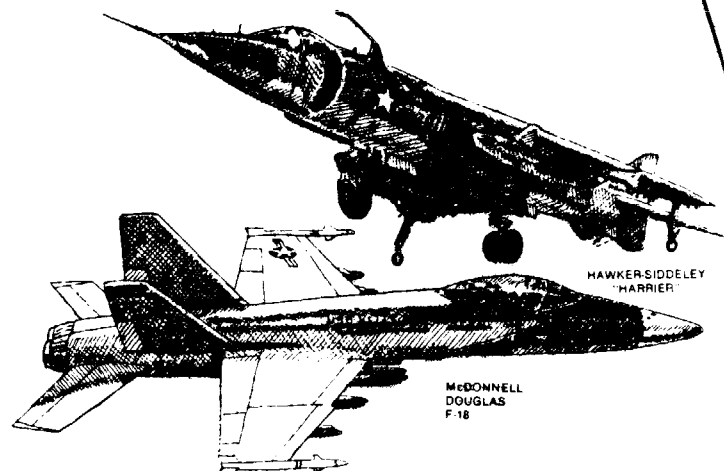
##### AIRLINE



##### GENERAL

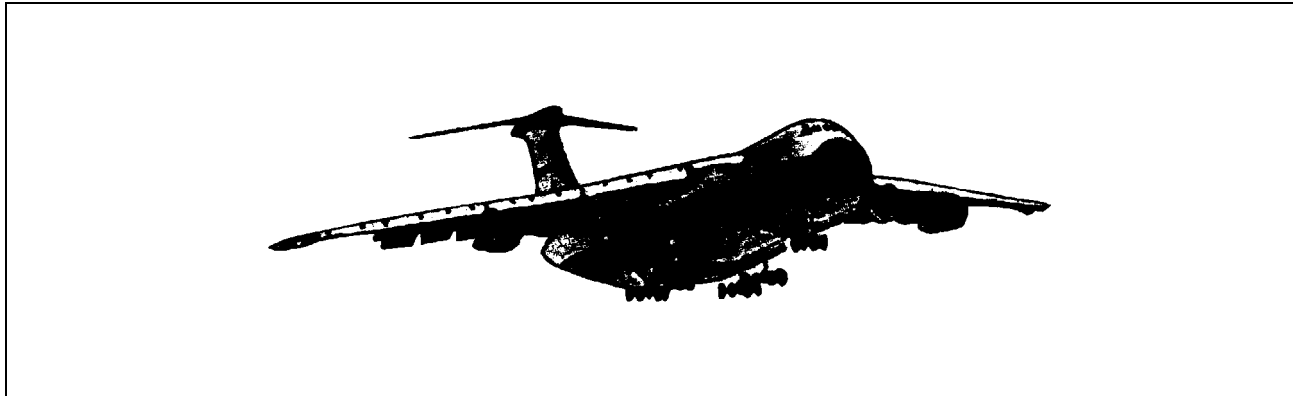


##### MILITARY



## UNIT 2 ACTIVITY 8

### STUDENT HANDOUT 14



C-5 GALAXY

The C-5 is the world's largest transport aircraft. It is almost as long as a football field and as high as a six-story building. The nose and rear doors open at the same time. Cargo moves out the rear door as cargo is loaded through the nose opening.

The C-5 has 28 wheels, four engines under the wings, and six fuel tanks in each wing.

It takes a crew of six to fly it. A relief crew of seven and eight also help.

## UNIT 2 ACTIVITY 8

### STUDENT HANDOUT 15

#### C-5 GALAXY

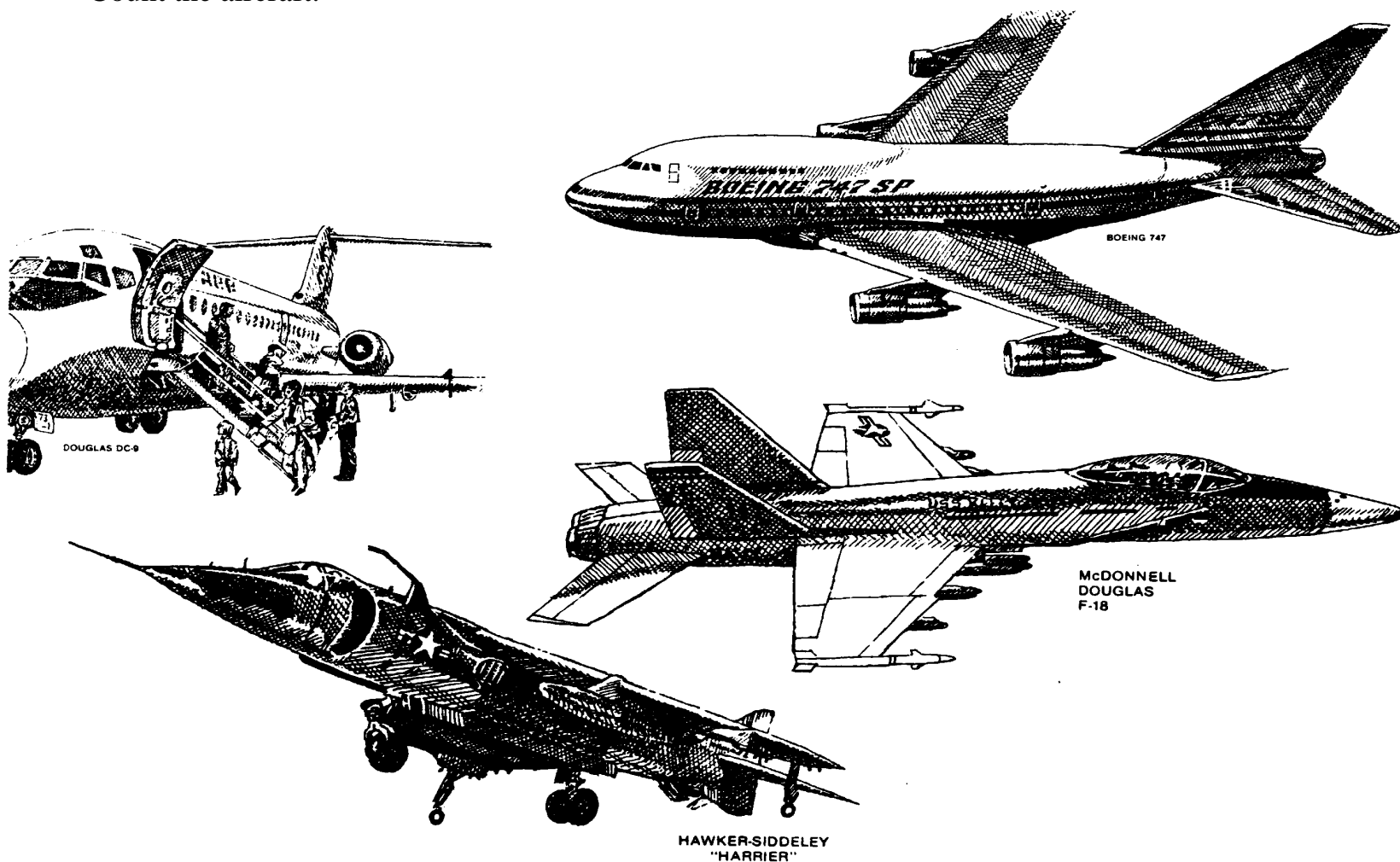
Directions: Read each problem. Add or subtract.

1. The C-5 has 28 wheels. The mechanic replaces 6 tires. How many tires are in good condition?
2. The C-5 has a wing on each side of the fuselage. Two engines are attached under each wing. How many engines does the C-5 have?
3. The C-5 has 12 fuel tanks. Two tanks are empty. How many tanks are full?
4. The C-5 has a crew of 6, a relief crew of 7 and 8. How many men help fly the plane?
5. Draw a picture of the C-5 loading and unloading cargo.

## UNIT 2 ACTIVITY 9

### STUDENT HANDOUT 16

Directions: Color the military aircraft blue.  
Color the airline aircraft red.  
Count the aircraft.



\_\_\_\_\_military aircraft

\_\_\_\_\_airline aircraft

## UNIT 2 ACTIVITY 10

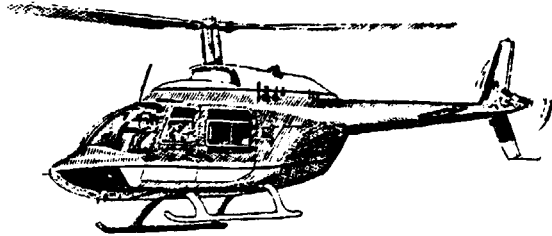
### STUDENT HANDOUT 17

Directions: Use the word bank. Name the user of each aircraft.

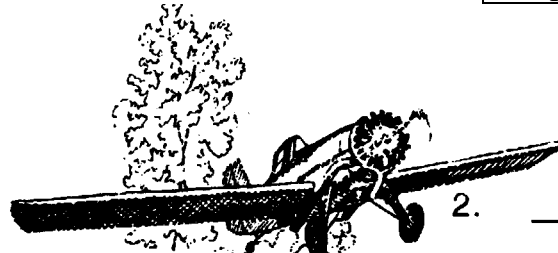
#### WORD BANK

business men      farmer

hospital      sport pilot



1. \_\_\_\_\_



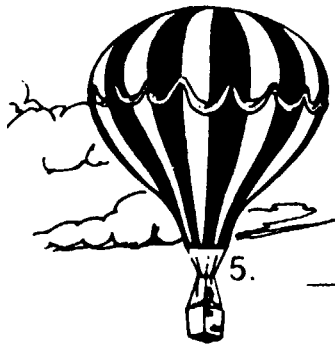
2. \_\_\_\_\_



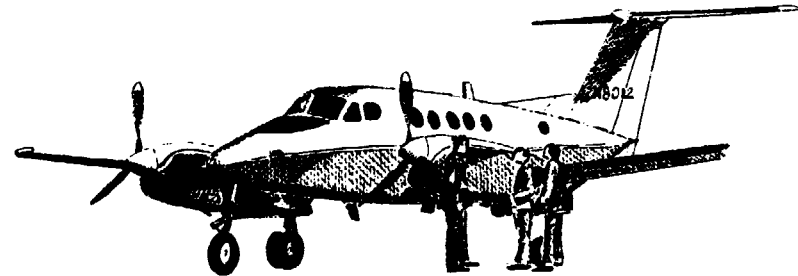
3. \_\_\_\_\_



4. \_\_\_\_\_



5. \_\_\_\_\_

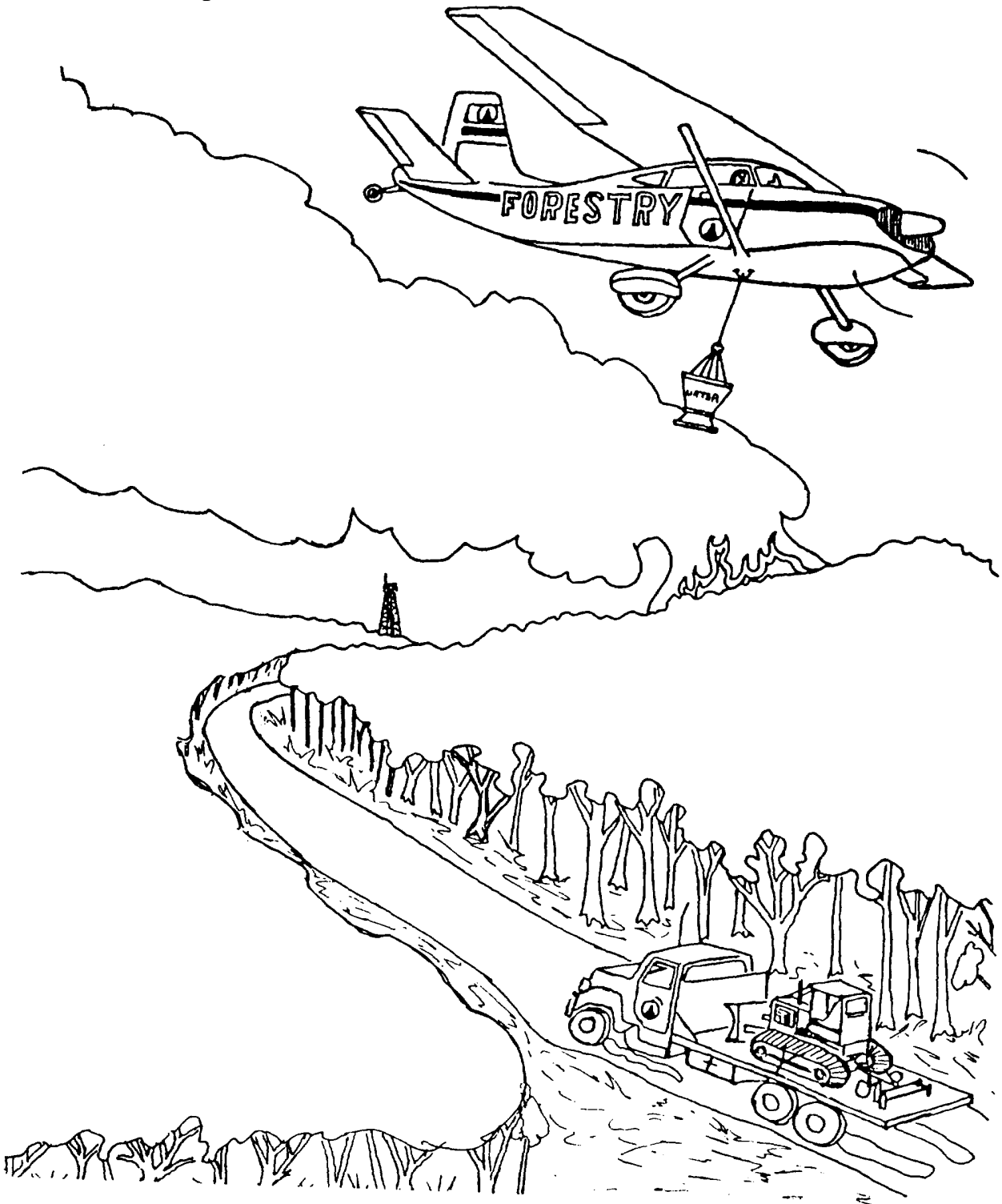


6. \_\_\_\_\_

## UNIT 2 ACTIVITY 10

### STUDENT HANDOUT 18

Directions: Color the picture.





## **UNIT 2 ACTIVITY 10**

### **STUDENT HANDOUT 19**

Directions: Read the story.

Draw a picture of a crop duster planting wheat.

#### **THE CROP DUSTER**

The fields are wet. It is planting time. The farmer needs help. A crop duster can quickly fertilize and plant seeds with an airplane. The crop duster has a special plane. It can carry heavy loads of chemicals, seeds, and fertilizer.

## **UNIT 3: PARTS OF AN AIRPLANE**

### **PURPOSE OF UNIT 3**

The purpose of Unit 3 is to introduce students to the parts of an airplane. Specifically, students should:

1. identify the parts of a bird and a fish and relate them to similar parts on an airplane;
2. recognize the seven main parts of an airplane; and
3. develop an understanding of how the main airplane parts function.

### **MAJOR MESSAGES IN UNIT 3**

- Machines are made of many parts.
- All parts must work together for a machine to function properly.

## **BACKGROUND INFORMATION FOR UNIT 3**

Unit 3 consists of 1 topic:

### **TOPIC 1: AIRPLANE PARTS**

Topic 1 examines the seven main airplane parts. Parts of the airplane are compared with the parts of the bird and the fish.

## **VOCABULARY WORDS FOR UNIT 3**

Topic 1	wing
	fuselage
	landing gear
	cockpit
	propeller
	ailerons
	elevator
	rudder
	flaps
	engine

## TOPIC 1: AIRPLANE PARTS

The activities, suggested materials, grade level, and related subject areas for each activity are summarized below.

<b><u>ACTIVITY</u></b>	<b><u>MATERIALS NEEDED</u></b>	<b><u>GRADE LEVELS</u></b> <b><u>SUBJECT</u></b>
1. Birds, Fish, and Airplanes	Student Handouts 1 and 2	Grades K-3 science art
2. Airplane Parts	Student Handout 3 Cessna airplane model (See Teacher Resource section for source.) Student Handouts 4, 5, and 6 Fantastic Flight Dictionary	Grades K-3 science language arts

## **ACTIVITY 1: BIRDS, FISH AND AIRPLANES**

Direct the students' attention to birds and fish. Arouse an interest in the similarity of birds and fish as they compare to airplanes. This may be accomplished by using Student Handouts 1 and 2 and by asking questions such as the following:

### **STUDENT HANDOUT 1**

1. How is a bird like an airplane?
2. What parts of the bird are like airplane parts?
3. What parts of the bird gave man ideas for building airplanes?

### **STUDENT HANDOUT 2**

1. How is a fish like an airplane?
2. What parts of the fish are like airplane parts?
3. What part of the fish gave man ideas for building airplanes?

Emphasize the fact that birds and fish have many parts. Each part does something special. Explain that it takes all parts working together to make the bird fly or the fish swim. To clarify this point ask questions such as the following:

1. What happens if a bird loses the feathers on one wing?
2. What happens if a bird breaks a leg?
3. What happens if a fish loses part of his tail?

Explain that the bird has a tail, feet, body, and wings just like an airplane. Further explain that a fish has a body and a tail like an airplane. If we put the fish and bird parts together, we have parts equivalent to an airplane. To make the airplane fly, we add an engine to make it go and a pilot to steer it. Complete Student Handout 2 per directions at the bottom of the page.

## ACTIVITY 2: AIRPLANE PARTS

Begin by transferring the students' knowledge of fish and bird parts to airplane parts. Distribute Student Handout 3. Generate an interest in the different airplane parts by asking questions such as the following:

1. What parts on the airplane are like parts of a fish or a bird?
2. Do you think airplane parts work the same as those of a fish or a bird?
3. Do you see some parts that are different?
4. What makes these parts different?

Using Student Handout 3, the Cessna model airplane, and the information and diagrams that follow, explain each special airplane part as listed below.

### KINDERGARTEN - GRADE 1

fuselage  
wings  
tail  
wheels (landing gear)  
propeller  
engine

### GRADES 1-3

fuselage  
wings  
landing gear  
propeller  
engine  
cockpit  
ailerons  
elevator  
rudder  
flaps

### Fuselage

The fuselage is the central (middle) part of the airplane. Pilots, passengers, and cargo are carried inside the fuselage. The wings, engine, tail, and landing gear are attached to the fuselage. Old airplanes had an outside covering of fabric. Today, very light metal covers the fuselage.



## ACTIVITY 2 (Continued)

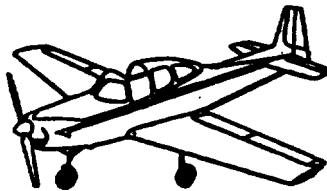
### Wings

Air flowing over the wings helps lift the airplane into the air. Most airplanes today have a wing attached to each side of the fuselage. These planes are called "monoplanes" because they have one set of wings. Some old airplanes, sport (fun) airplanes, and agricultural airplanes have two wings attached to each side of the fuselage. These planes are called "biplanes" because they have two sets of wings.



### Landing Gear

The wheels and the parts that attach the wheels to the fuselage make up the landing gear. The landing gear supports the airplane while on the ground. The landing gear is also used to taxi, takeoff, and land. The landing gear isn't needed in the air for flying. Therefore, during flight, large airplanes fold (retract) the landing gear into the fuselage or wing. This makes the airplane aerodynamic (sleek in shape). Small airplanes do not have landing gear that folds up.



## ACTIVITY 2 (Continued)

### Propeller

The propeller is a rotating blade attached to the engine in front of the airplane. The engine turns the propeller which pulls the airplane through the air. If an airplane has two engines, a propeller is attached to each engine.



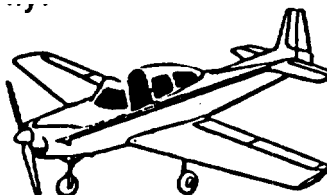
### Engine

The engine is the part that provides the power that moves the airplane through the air.

### Cockpit

The cockpit contains all the instruments that keep the pilot informed about how the various systems are working and whether he is on course.

In smaller planes the cockpit is usually the space in the fuselage for the pilot and passengers. In large airplanes, the cockpit is the space for pilot and flight crew only.

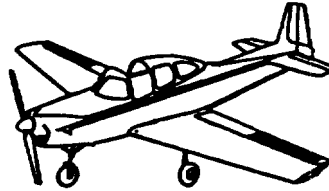




## ACTIVITY 2 (Continued)

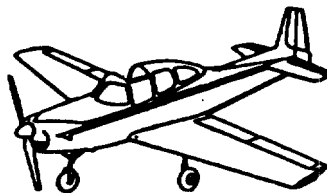
### Ailerons

The ailerons are moving parts attached to the outside rear edge of each wing. This part, when moved, makes the airplane tilt and roll to the left or right.



### Elevators

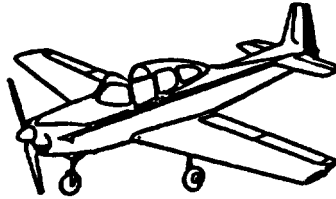
The elevators are moving parts attached to the horizontal section on each side of the tail. The elevators, when moved, make the airplane climb or descend.



## ACTIVITY 2 (Continued)

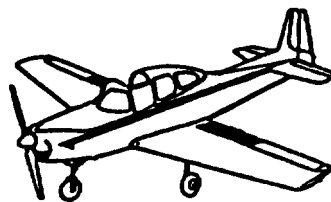
### Rudder

The rudder is a moving part attached to the vertical section of the tail. This part, when moved, makes the airplane turn to the left or to the right.



### Flaps

Flaps are moving parts attached to the inside rear edge of each wing. They help slow the airplane down for takeoff and landing.



## ACTIVITY 2 (Continued)

Distribute Student Handout 4 to kindergarten or first grade students.  
Complete per directions.

Distribute Student Handout 5 to students in grades 1-3. Complete per directions.

Distribute Student Handout 6 to students in grades 2-3. Complete per directions.

Student Handout 6 answers:

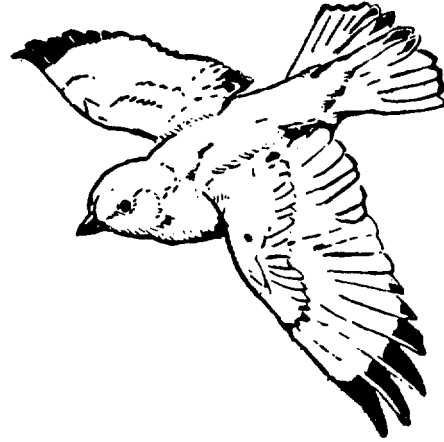
- |              |                 |
|--------------|-----------------|
| 1. cockpit   | 5. flaps        |
| 2. rudder    | 6. aileron      |
| 3. elevator  | 7. landing gear |
| 4. fuselage  | 8. wings        |
| 9. propeller |                 |

### Extended Activities ,

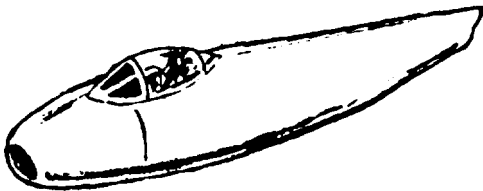
- Draw a large airplane on poster board. Label each part. Cut out each labeled part. Ask students to assemble the puzzle.
- Make a name card for each airplane part. Place cards in a box. Have students draw a card from the box. Ask students to identify the word, locate the part on the Cessna model or similar model, and demonstrate its function.
- Write Topic 1 vocabulary words on the board. Ask the students to do exercises such as the following:
  1. Write the words in alphabetical order.
  2. Write the words in the Fantastic Flight Dictionary.
  3. Write a sentence with each word.

## UNIT 3 ACTIVITY 1

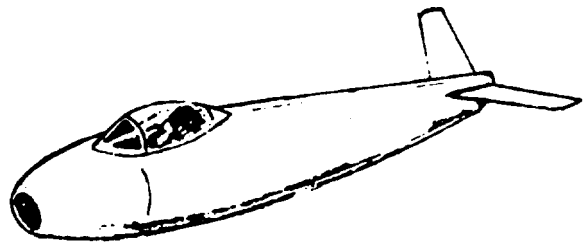
### STUDENT HANDOUT 1



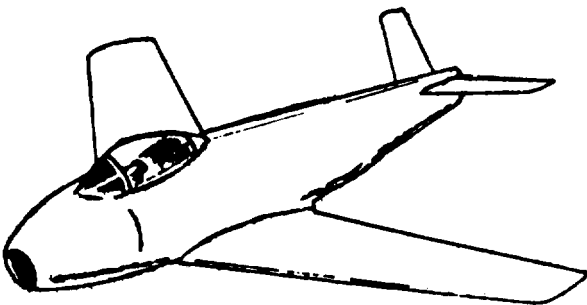
AN AIRPLANE IS LIKE A BIRD



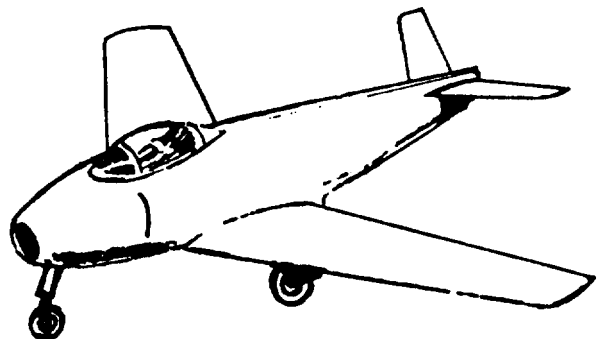
It has a body.



It has a flat tail.



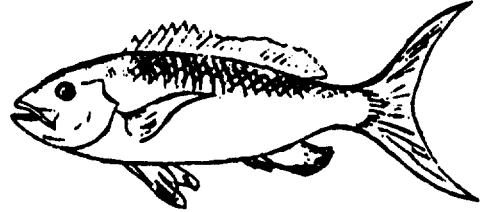
It has wings.



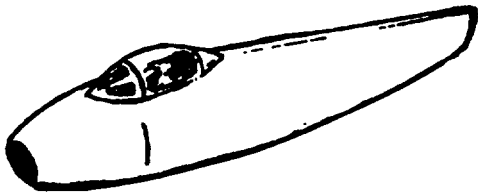
Its wheels are like feet.

## UNIT 3 ACTIVITY 1

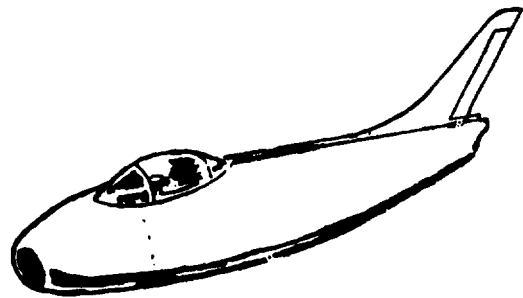
### STUDENT HANDOUT 2



AN AIRPLANE IS LIKE A FISH



It has a body.



It has a tail called a rudder.

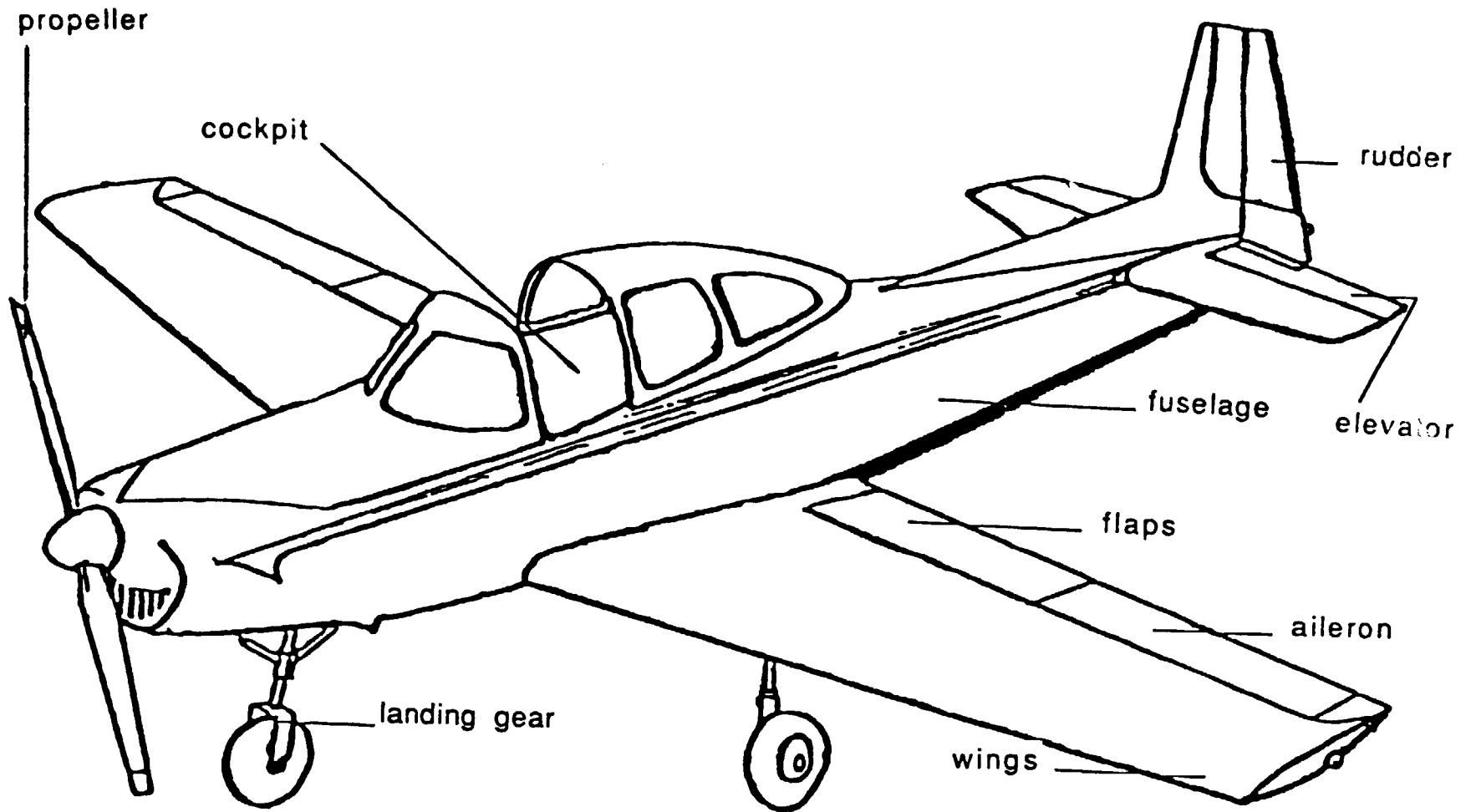
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Directions: Draw an airplane by putting the bird and fish parts together.

## UNIT 3 ACTIVITY 2

### STUDENT HANDOUT 3

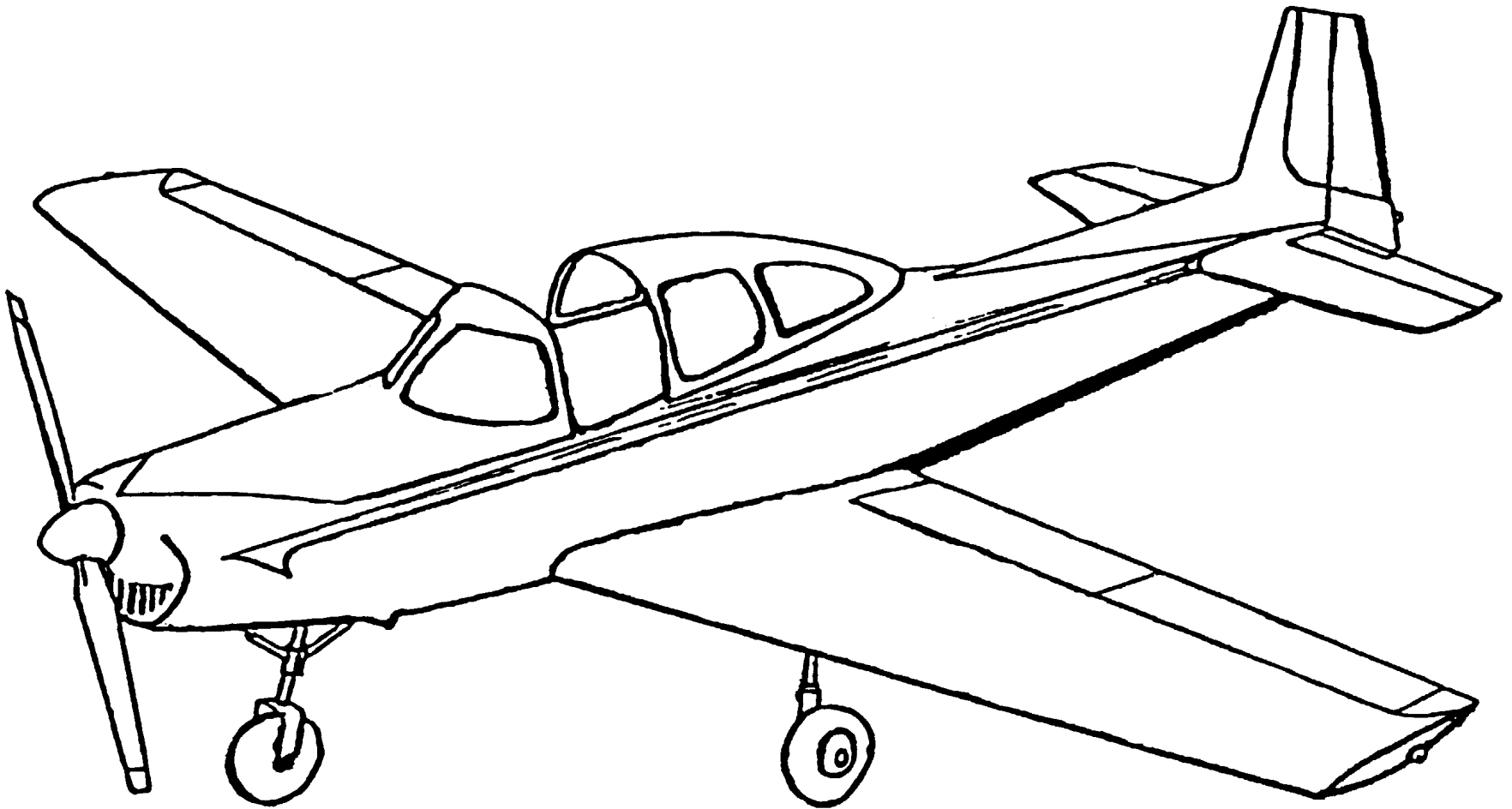
#### AIRPLANE PARTS



## UNIT 3 ACTIVITY 2

### STUDENT HANDOUT 4

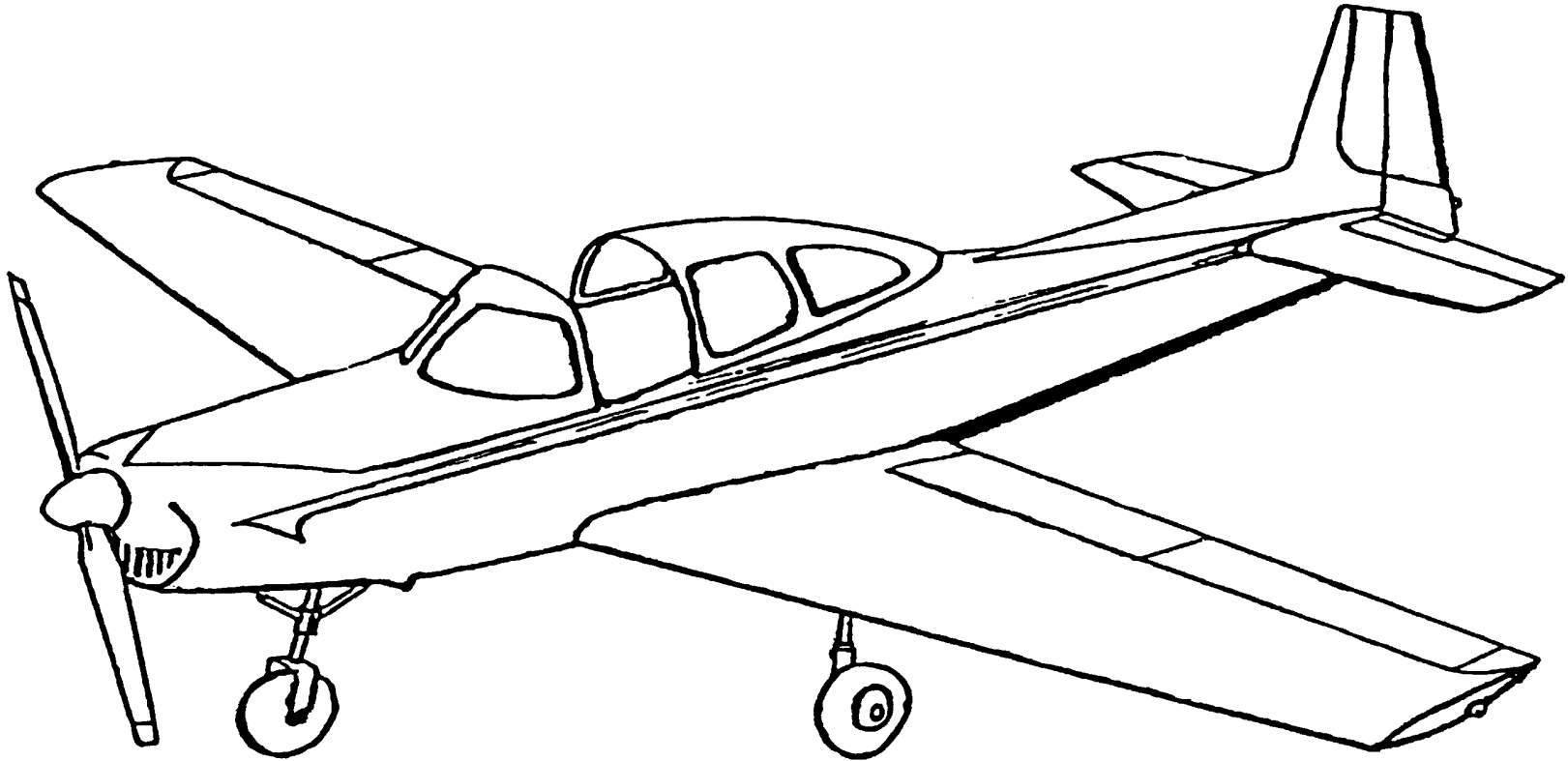
Directions: Color the wings red.  
Color the fuselage green.  
Color the tail blue.  
Color the wheels black.



## UNIT 3 ACTIVITY 2

### STUDENT HANDOUT 5

Directions: Color the flaps brown.  
Color the fuselage blue.  
Color the landing gear green.  
Color the propeller black.  
Color the ailerons orange.  
Color the elevators purple.  
Color the rudder red.  
Color the wings yellow.

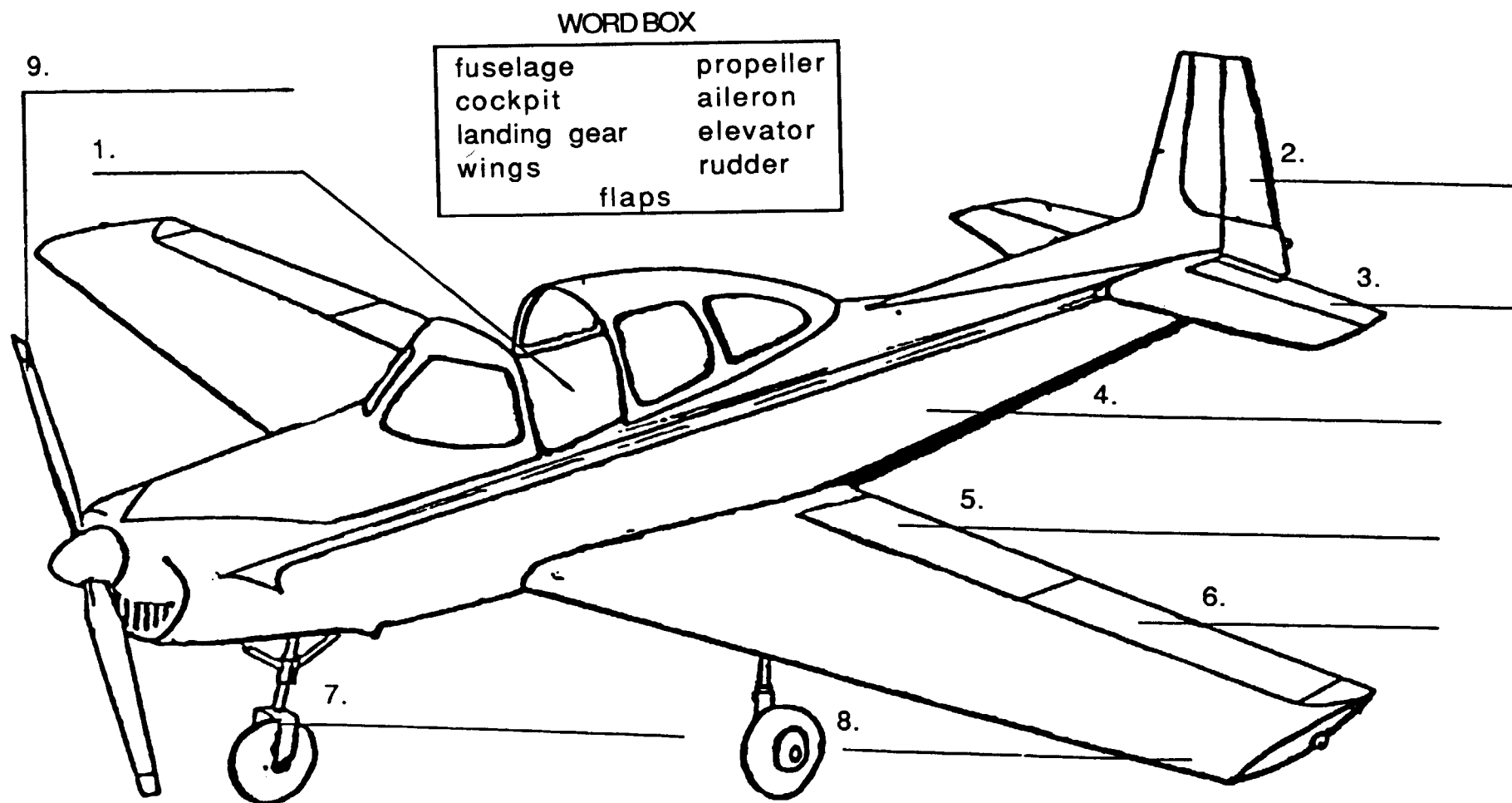




## UNIT 3 ACTIVITY 2

### STUDENT HANDOUT 6

Directions: Discuss words in the word box. Label each part.



## **UNIT 4: WHY AIRCRAFT FLY**

### **PURPOSE OF UNIT 4**

The purpose of Unit 4 is to introduce the theory of flight. Specifically, students should:

1. demonstrate how lift can overcome weight (gravity);
2. demonstrate how thrust (power) can overcome drag (air resistance);
3. recognize the importance of aerodynamics in daily activities;
4. experience firsthand that for every action there is an equal and opposite reaction;  
and
5. develop an understanding of how the pilot controls an aircraft.

### **MAJOR MESSAGES IN UNIT 4**

- There are four forces that affect flight: lift, gravity, thrust, and drag.
- There are three basic aircraft movements: turn (yaw), climb and descend (pitch), and lean to the left or right (roll).

## **BACKGROUND INFORMATION FOR UNIT 4**

Unit 4 consists of 3 topics:

**TOPIC 1: FOUR FORCES OF FLIGHT**

**TOPIC 2: JET PROPULSION**

**TOPIC 3: THREE BASIC AIRCRAFT MOVEMENTS**

Topic 1 introduces the four forces of flight as lift, gravity, thrust, and drag. Topic 1 emphasizes that gravity (weight) and drag (bulky shape) must be overcome by lift and thrust in order for an aircraft to become airborne.

Topic 2 introduces Newton's Third Law of Physics: for every action there is an equal and opposite reaction.

The three basic aircraft movements, roll, pitch, and yaw, are examined in Topic 3.

## **VOCABULARY WORDS FOR UNIT 4**

Topic 1

lift  
thrust  
weight  
gravity  
drag  
propel  
aerodynamic

Topic 2

jet  
propulsion

Topic 3

roll  
pitch  
yaw

## TOPIC 1: FOUR FORCES OF FLIGHT

The activities, suggested materials, grade level, and related subject areas for each activity are summarized below.

	<b><u>ACTIVITY</u></b>	<b><u>MATERIALS NEEDED</u></b>	<b><u>GRADE LEVELS</u></b> <b><u>SUBJECT</u></b>
1.	Lift Versus Weight	2" x 10" paper strips hard back book	Grades 1-3 science
2.	Thrust		Grades 1-3 science
3.	Drag	2 sheets of typing paper	Grades 1-3 science
4.	Culmination	Student Handout 1 Student Handout 2 Fantastic Flight Dictionary	Grades 2-3 science

## ACTIVITY 1: LIFT VERSUS WEIGHT

Probe students' imagination by asking questions such as the following:

1. Will an airplane float like a balloon? Why?

Answer: No, it is too heavy.

2. What holds an airplane on the ground?

Answer: Weight (gravity) holds an airplane on the ground.

3. If an airplane will not float, then what lifts it into the air?

Answer: Air moving over the wings creates lift greater than the weight of the airplane.

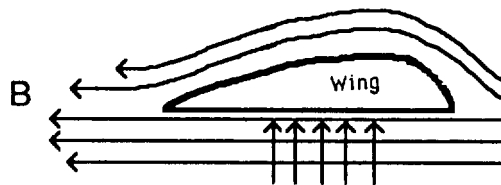
Explain to the students that weight or gravity holds an airplane on the ground. Therefore, a force greater than the weight of the plane must be used to lift it. Tell the students that the force that lifts an aircraft and keeps it airborne is created by the air flowing over the wings and the angle of the wings into the wind. Most aircraft wings are flat on the bottom and curved on the top.

## ACTIVITY 1 (Continued)

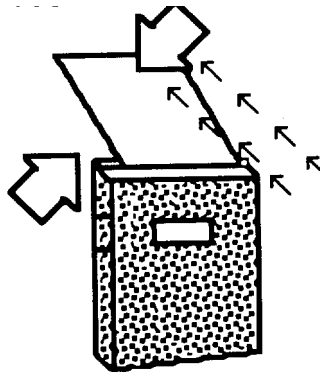
Draw the following diagram on the board to show and explain the cross section of a wing:



Explain that air traveling over the wing must reach point B (see diagram below) at the same time as the air traveling under the wing. This means the air traveling over the wing must go faster. This creates a lower air pressure. Lower air pressure creates a suction which causes the wing to lift upward. Draw the following diagram on the board to illustrate lift.



Distribute 2" x 10" paper strips. Ask students to make a wing by placing one end of the paper strip between the pages of a book so that the other end hangs over the top of the book.



Encourage students to analyze what will happen when air passes over the strip of paper by asking questions similar to the following:

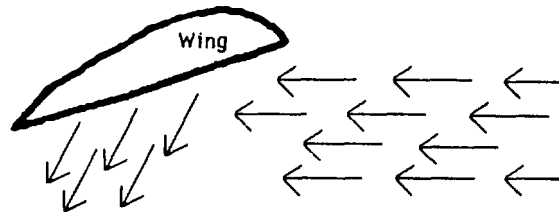
1. What will the paper do with no air passing over it?
2. Will the paper move up or down with air passing over it?

Tell students to blow across the top of the paper strip. Ask students to explain what happened.

## ACTIVITY 1 (Continued)

### Extended Activities

- Explain to the students that air flowing over the wing is not the only thing needed to lift the aircraft, but also the wing must hit the air at the correct angle. Use the following diagram on the board for explanation.

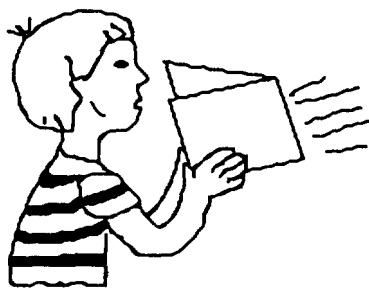


Further explain that the aircraft will climb or lift higher according to the angle of the wing.

- Hold two sheets of notebook paper about four inches apart. Blow between them.

Question: What happens? Why?

Answer: The paper comes together. The rapid movement of air between the two pieces of paper creates less pressure than the air pressing on the outer sides of the paper.





## ACTIVITY 2: THRUST

Explain to the students that thrust is the force needed to propel an aircraft through the air. Pose questions, for student thought, such as the following:

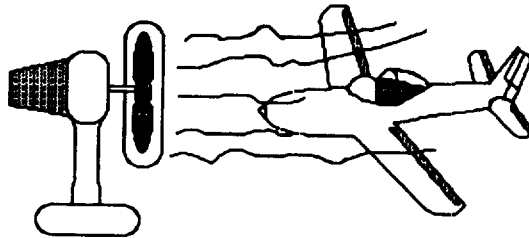
1. What is used to thrust (propel) an aircraft through the air?

Answer: Add an engine to thrust an aircraft through air.

2. What can be done to thrust an aircraft through the air faster?

Answer: To thrust an aircraft through the air faster, reduce drag or increase power.

Allow time for discussion. After considering a variety of ideas, tell students that an airplane propeller, turned by the engine, pulls the airplane through the air as it blows air over the wings and fuselage. Illustrate how the propeller pulls an airplane through the air by drawing the following sketch on the board. Pretend the fan is the propeller.



After discussing the sketch, ask students to consider the following question:

Where would you stand so you could feel the wind of the propeller --- in front of the plane or behind it?

### ACTIVITY 3: DRAG

Explain to the students that, while the propeller pulls the airplane forward, another force called drag holds the airplane back. Air can not flow quickly around large-bulky objects. In order for objects to travel quickly through the air, they must be streamlined (aerodynamic). Show students a crumpled piece of paper and a piece left as is. Ask questions such as the following:

1. If dropped, which piece will hit the floor first?
2. If thrown, which piece will go the farthest?

Give each student two sheets of paper. Ask them to crumple one and leave the other as is.

1. Drop each piece from a predetermined height.
2. Throw each piece.

After the experiment, pose the following question to the students:

Question: Why did the crumpled piece travel the fastest in both cases?

Answer: The crumpled piece had less drag (resistance to the air) because it was more streamlined or compact. Therefore, it traveled through the air faster with less drag.

#### Extended Activities

- Ask students to think of other ways aerodynamics (streamlining) is used. Ask students to give reasons for using aerodynamics (speed and fuel efficiency).

Examples: cars  
trucks --- sleek cab designs with air spoilers between the truck and the trailer  
clothing---tights used by speed skaters and bicyclist  
motorcycles  
speed boats

### **ACTIVITY 3 (Continued)**

- Experiment with paper airplanes. Have students discover how sleek designs travel through the air faster than bulkier designs.
- Brainstorm ways in which drag can be reduced on an airplane.

Examples: Put a hood (cowling) over the engine.  
Make the fuselage design sleek and streamlined.  
Put a cover over the open cockpit.  
Pull wheels up inside the fuselage or wing.

## ACTIVITY 4: CULMINATION

Distribute Student Handout 1. Review the four forces of flight.

- Major review points:
1. Two forces keep an airplane from flying: weight (gravity) and drag (bulky shape).
  2. Lift and thrust must overcome weight and drag before an airplane will fly.

Distribute Student Handout 2. Complete per directions.

- Answers:
- |            |            |
|------------|------------|
| 1. Lift    | A. Lift    |
| 2. Thrust  | B. Drag    |
| 3. Gravity | C. Thrust  |
| 4. Drag    | D. Gravity |

### Extended Activities

- Discuss problems such as the following:
  1. How can the lift on an aircraft be increased?  
Answer: Increase the speed of the air passing over the wing. Increase the angle of the wing into the wind.
  2. What parts of an aircraft cause drag?  
Answer: landing gear (wheels)  
open cockpit  
wing supports  
exposed engine  
bulky fuselage shape
  3. How can drag be reduced on a car?
  4. How can drag be reduced on a truck and trailer?
  5. How can a bicyclist reduce drag to gain speed?
- Write Topic 1 vocabulary words in Fantastic Flight Dictionary.

## TOPIC 2: JET PROPULSION

The activities, suggested materials, grade level, and related subject areas for each activity are summarized below.

<u>ACTIVITY</u>	<u>MATERIALS NEEDED</u>	<u>GRADE LEVELS</u> <u>SUBJECT</u>
5. Balloon Jet	string tape straw balloon	Grades 1-3 science
6. Newton's Third Law of Physics	glass bottle cork vinegar water baking soda pencils vaseline	Grades 2-3 science

## ACTIVITY 5: BALLOON JET

Begin by directing students' attention to jets. Ask questions that arouse curiosity such as the following:

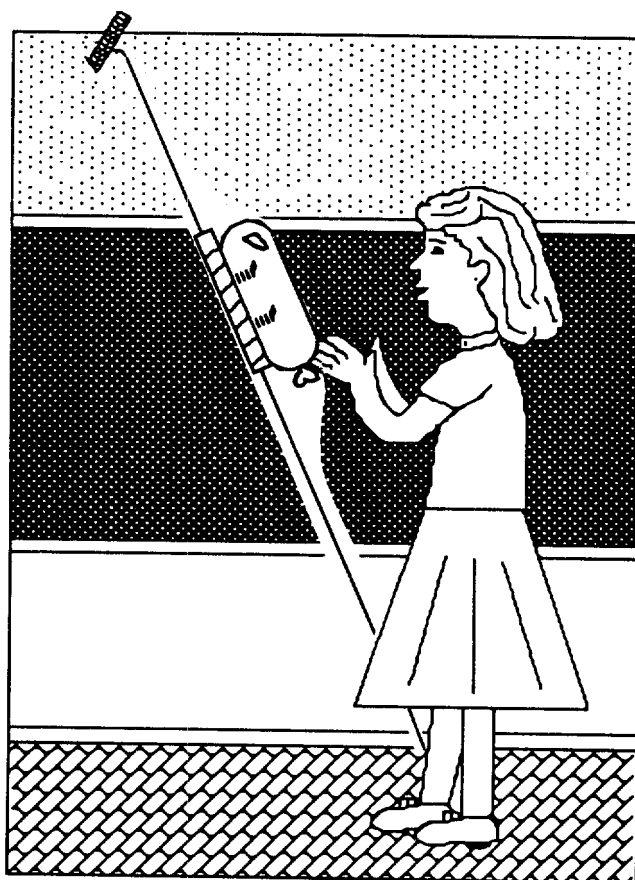
1. Do all airplane engines have a propeller?
2. What kind of airplane engine has no propeller?
3. How do jet engines provide thrust?
4. Do you think jets are like rockets?

Explain to students that the fuel burned in a jet engine gives off hot gases. The gases shoot out the back of the engine in a stream called a jet. As the gas shoots out the back of the engine, the jet airplane is pushed forward. This forward movement is called thrust or jet propulsion.

Conduct the following experiment to illustrate. Tape a string to the ceiling or tall bookcases. Thread the loose end through a straw and tape it to the floor at a 45° angle. Inflate a balloon and tape it to the straw. Let students take turns inflating a balloon and releasing the neck. Ask students questions such as the following:

Conduct the following experiment to illustrate. Tape a string to the ceiling or tall bookcases. Thread the loose end through a straw and tape it to the floor at a 45° angle. Inflate a balloon and tape it to the straw. Let students take turns inflating a balloon and releasing the neck. Ask students questions such as the following:

1. What did the balloon do?
2. What caused the balloon to travel to the ceiling?
3. How does the balloon compare to a jet engine?

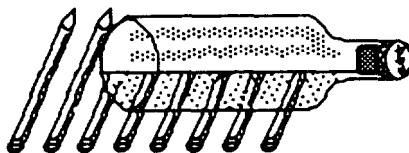


## ACTIVITY 6: NEWTON'S THIRD LAW OF PHYSICS

Tell the students that for every action there is an equal and opposite reaction just like every problem has a cause. Ask students to examine the following actions and determine the reaction.

1. Tossed ball
2. Air escaping from a balloon

Illustrate by conducting the following experiment. Fill a glass bottle, half full, with a mixture of 50% water and 50% vinegar. Pour two teaspoons of baking soda into the bottle. Lubricate a cork with Vaseline and insert in the bottle top. Place the bottle on its side on a row of round pencils.



After completing the experiment, help the students assess the outcome by asking questions such as the following:

1. What was the action?
2. Describe the reaction?
3. Explain what caused the reaction.
4. Relate the reaction to a jet engine.

Note: The pressure build-up inside the bottle, caused by the vinegar, water, and baking soda mixture, will pop the cork. The force exerted to pop the cork will thrust (push) the bottle in the opposite direction across the pencils.

Caution: Clear the work area to accommodate possible spillage of the vinegar, water, and baking soda mixture.

### TOPIC 3: THREE BASIC AIRCRAFT MOVEMENTS

The activities, suggested materials, grade level, and related subject areas for each activity are summarized below.

<b><u>ACTIVITY</u></b>	<b><u>MATERIALS NEEDED</u></b>	<b><u>GRADE LEVELS</u></b> <b><u>SUBJECT</u></b>
7. Control Parts	Student Handout 3 Cessna airplane model (See Teacher Resource Section for address.) Student Handout 4	Grades K-3 mathematics science
8. Turns	Cessna airplane model 2 1/2" x 8" paper strips	Grades 1-3 mathematics science
9. Climb and Descend	Student Handout 5	Grades 1-3 science
10. Roll	Student Handout 5	Grades 1-3 science
11. Culmination	Student Handout 6 Fantastic Flight Dictionary	Grades 1-2 science



## ACTIVITY 7: CONTROL PARTS

Begin by directing the students' attention to how a driver controls a car. Arouse interest by asking questions such as the following:

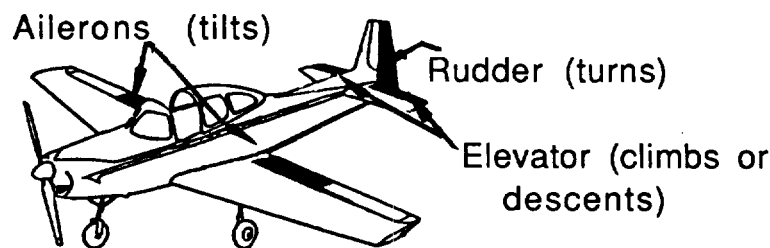
1. How does a driver make the car turn left or right?
2. What part of the car does the steering wheel control?
3. Does the steering wheel control any other part of the car?
4. What control, inside the car, causes the car to stop and go?
5. What control, inside the car, causes the car to go forward or reverse?

Explain to students that a pilot controls his airplane, from the cockpit, just like a driver controls a car. Stimulate the students' curiosity by asking questions such as the following:

1. What kind of movements can an airplane make?
2. What movements can an airplane make that are impossible for a car to make?
3. What movement can a car make that is impossible for an airplane to make?

Answers: 1. Turns, rolls, climbs, descents, and straight/level  
2. Rolls, climbs, and descents  
3. Reverse

Distribute Student Handout 3 and the Cessna airplane model. Direct the students' attention to the parts of the airplane that control the way it moves.



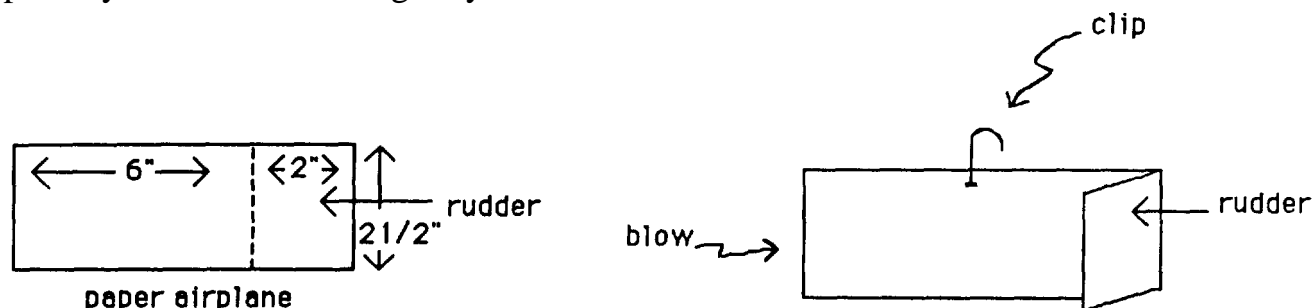
Distribute Student Handout 4. Complete per directions.

Answers: 1. elevator 2. rudder 3. aileron

## ACTIVITY 8: TURNS

Explain to the students that the airplane has two rudder pedals in the floor of the cockpit that attach to the rudder with cables. (Check rudder location on the Cessna model.) When the pilot wants to go left, he pushes the left rudder pedal with his foot. The cable pulls the rudder, on the tail, to the left so the wind hits it and pushes the plane to the left.

Give each student a paper clip and a 2 1/2" x 8" strip of paper. Have students pretend the flat paper strip is an airplane. Fold the paper 2" from one end to form a rudder. Push a clip through the paper 2 1/2" from the fold. Hold the clip so that the folded end (rudder) of the paper is opposite your mouth. Blow gently.



Ask students to perform experiments such as the following:

1. Determine what direction the plane turns when the rudder is folded to the left.

Outcome: Air hitting the rudder, that is folded to the left, pushes the tail of the airplane to the right which points the nose of the airplane to the left. The plane is now making a left turn.

2. Determine what direction the plane turns when the rudder is folded to the right.

Outcome: Air hitting the rudder, that is folded to the right, pushes the tail of the airplane to the left which points the nose of the airplane to the right. The plane is now making a right turn.

## ACTIVITY 9: CLIMB AND DESCEND

Tell the students that the pilot also uses a long joy stick or yoke, like a car steering wheel, to control an airplane from the cockpit. The joy stick or yoke attaches to the elevators with cables. When a pilot wants to make his airplane climb higher, he pulls the joy stick or yoke back. The elevators turn up so the wind hits them. The wind pushes the tail of the airplane down, causing the nose to point upward.

Distribute Student Handout 5. Cut and fold paper airplane per directions. Tell students to conduct the following experiments to clarify the effect of the wind on the elevator control surfaces:

### Experiment: 1

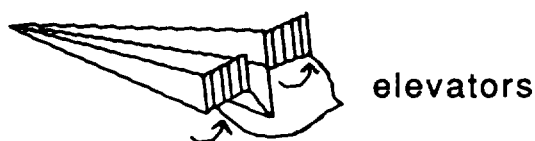


fig. 1

To make the airplane climb, fold both elevators up (fig. 1). Air hitting the elevators pushes the airplane tail down, causing the nose to point upward.

### Experiment: 2



fig. 2

To make the airplane descend, fold both elevators down (fig. 2). Air hitting the elevators pushes the airplane tail up, causing the nose to point down.

Take students to an outside play area. Allow ample time for experimentation with elevators folded up and elevators folded down. Ask students to consider what would happen if the elevators were in a neutral (flat) position.

## ACTIVITY 10: ROLL

Direct students' attention to what made an airplane climb, descend, and turn. Review the control surfaces that make these movements take place. Now ask a question such as the following:

What can be done with the controls to make the airplane roll or tilt to the right or left?

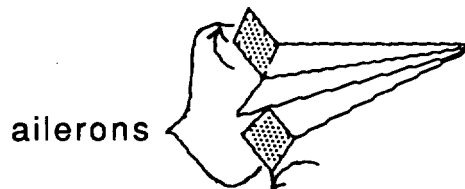
After the students have attempted various answers, tell them that the ailerons make the airplane roll or tilt. The ailerons are located on the outer section of the rear edge of the wing. A cable connects the ailerons to the joy stick or control wheel (yoke).

To make a plane roll to the right, the control wheel or joy stick must be turned to the right. The left aileron moves down so the wind pushes the wing up. The right aileron moves up so the wind pushes the wing down.

Tell the students the opposite must be done to make the plane roll to the left: left aileron must be up and the right aileron must be down.

Distribute Student Handout 5. Cut and fold the paper airplane per directions. Pretend the folded parts are the ailerons located on the airplane wing. Take the students outdoors to conduct the following experiment:

fig. 1



To make the airplane roll to the left, fold left aileron up and the right aileron down (fig.1).

Outcome: The paper airplane will roll or tilt to the left during flight.

## **ACTIVITY 10 (Continued)**

To make the airplane roll to the right, fold the left aileron down and the right aileron up. This is the reverse of fig. 1.

Outcome: The paper airplane will roll or tilt to the right during flight.

## ACTIVITY 11: CULMINATION

Explain that the controls of an airplane must all work together. The pilot can make the airplane climb, turn, and roll all at the same time.

Conduct a brainstorming session to help students visualize the simultaneous operation of the controls to produce specific airplane movements. Ask questions such as the following:

- Questions:
1. What makes an aircraft fly straight and level?
  2. What would you do to make the aircraft climb and turn right at the same time?
  3. What would you do to make the aircraft descend and turn left at the same time?

- Answers:
1. Put all controls in neutral--do not push, pull, or turn.
  2. Pull the control wheel back, turn the wheel to the right, and push right rudder.
  3. Push the control wheel in, turn the wheel left, and push left rudder.

### Extended Activities

- Distribute Student Handout 6. Complete per directions.

Answers:	1	elevator	2.	rudder	3.	aileron
	4.	climb	5.	descend	6.	left turn
	7.	tilt right				

- Ask students to alphabetize Topic 1, 2, and 3 vocabulary words.
- Tell students to write Topic 2 and 3 vocabulary words in the Fantastic Flight Dictionary.

## UNIT 4 ACTIVITY 4

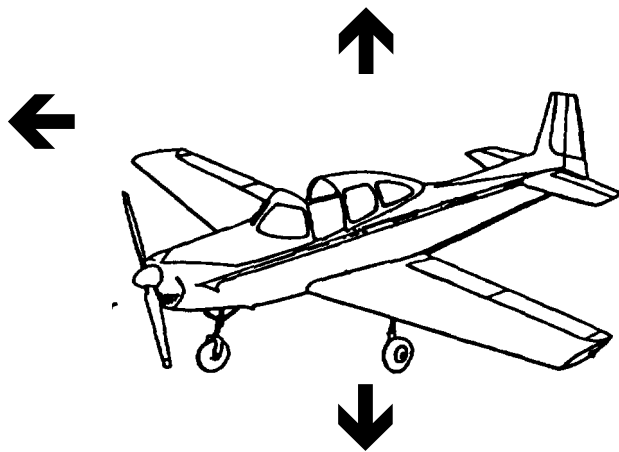
### STUDENT HANDOUT 1

#### WHY AIRCRAFT FLY

##### LIFT

Air flowing over the wings and the angle of the wing into the wind moves the aircraft upward.

**THRUST**  
The engine turns the propeller. The propeller pulls the aircraft forward.



**DRAG**  
The shape of the aircraft slows its forward movement.

##### GRAVITY

Weight holds the aircraft down.

#### To make an aircraft fly:

1. Lift must be greater than gravity (weight).
2. Thrust (power) must be greater than drag.

## UNIT 4 ACTIVITY 4

### STUDENT HANDOUT 2

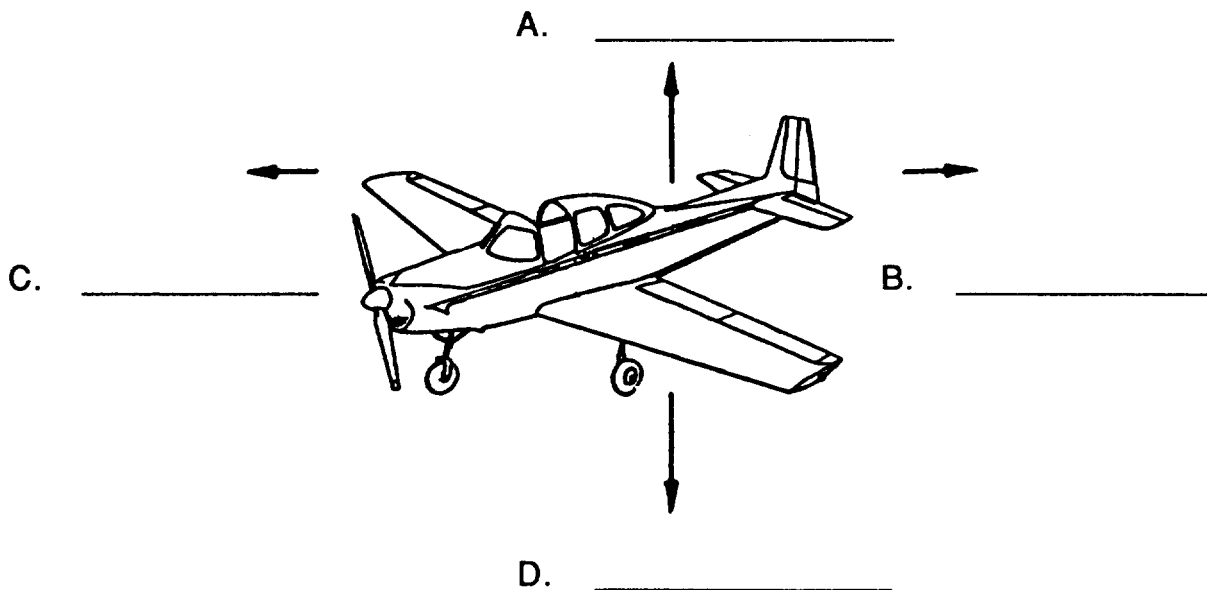
Directions: Fill in the blank with the appropriate term. Label the airplane.

#### FOUR FORCES OF FLIGHT

##### Word Bank

Drag	Thrust
Lift	Gravity

1. \_\_\_\_\_ is produced by air flowing over the wings and the angle of the wing into the wind.
2. \_\_\_\_\_ is the forward movement produced by an engine-driven propeller, jet, or rocket engine.
3. \_\_\_\_\_ is the force that pulls an aircraft down.
4. \_\_\_\_\_ slows the forward movement of an aircraft.

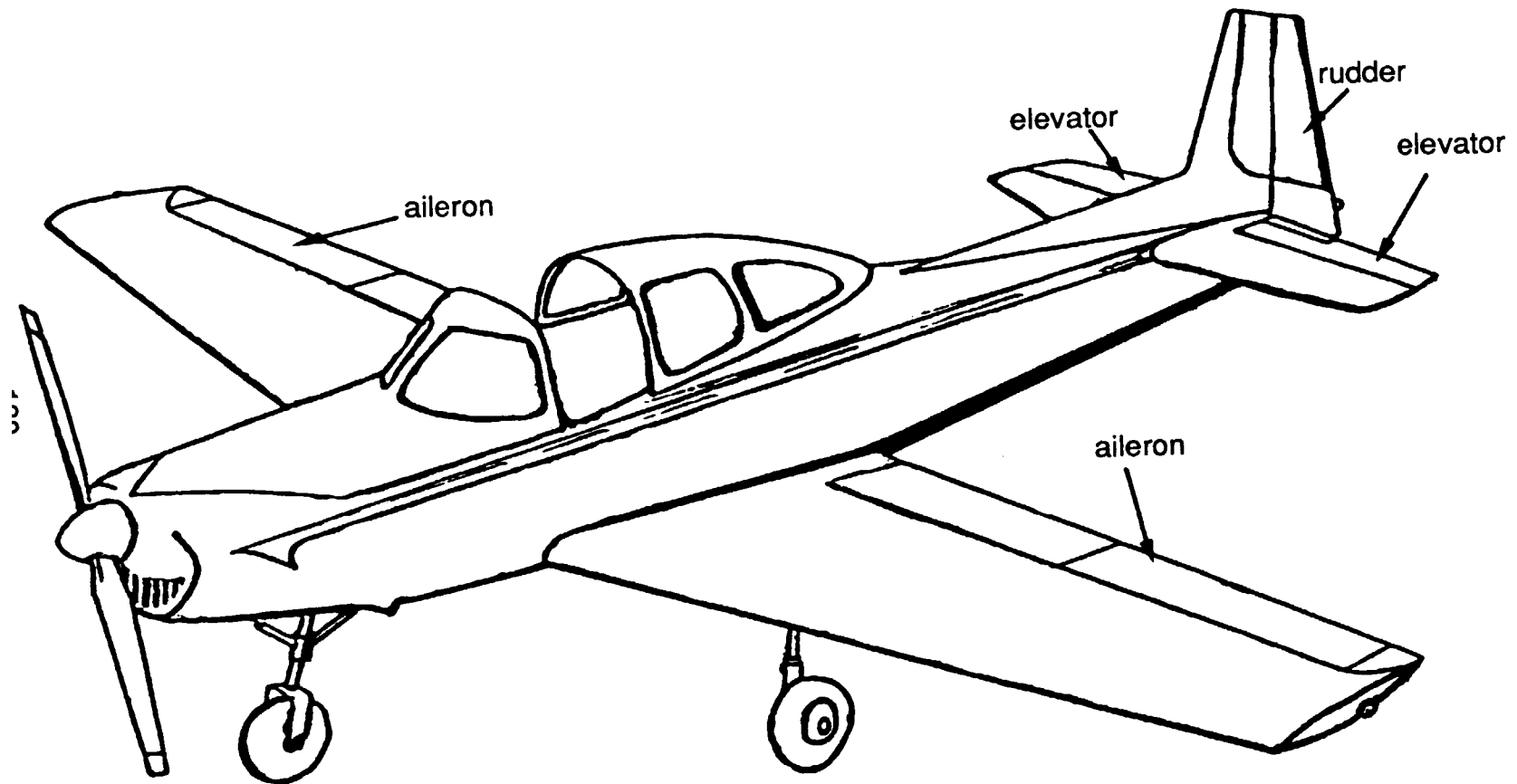




## UNIT 4 ACTIVITY 7

### STUDENT HANDOUT 3

#### PARTS THAT CONTROL AIRPLANE MOVEMENT



The ELEVATOR makes the plane climb or descend.

The RUDDER turns the plane left or right

The AILERON makes the plane tilt left or right.